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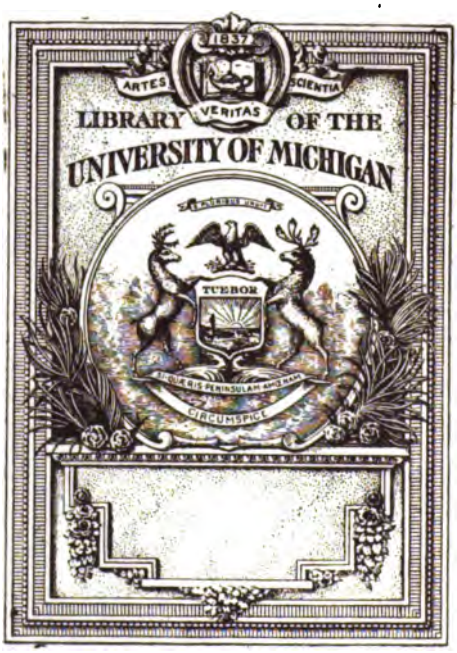
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QUARTERLY JOURNAL

OF

THE METEOROLOGICAL SOCIETY.

EDITED BY

A COMMITTEE OF THE COUNCIL.

VOL. IX.

LONDON:
EDWARD STANFORD, 55 CHARING CROSS, S.W.;
WILLIAMS AND STRAHAN, 7 LAWRENCE LANE, E.C.
1883.

LONDON:
PRINTED BY WILLIAMS AND STRAHAN,
7 LAWRENCE LANE, CHEAPSIDE.

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ERRATUM.

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QUARTERLY JOURNAL

OF

THE METEOROLOGICAL SOCIETY.

VOL. IX. No. 45.

ON CERTAIN TYPES OF BRITISH WEATHER.

By the HON. RALPH ABERCROMBY, F.M.S.

[Read November 15th, 1882.]

IT is familiar to many observers, that the weather in this country frequently occurs in spells of several weeks' duration, during which there is a remarkable persistence of the general type of weather overriding both a considerable fluctuation from day to day, and a considerable local variation from place to place.

For instance, the wind will often back to some point of South, with a high temperature, a dull sky and rain, and then veer to some point of West with a cooler air and brighter sky; and after a day or so of fine weather, it will back again to the South with bad weather, perhaps this time rising to the intensity of a gale, and subsequently veer towards the West with finer weather, and so on for weeks together.

The changes only vary in intensity and detail, not in general character, while the feel of the weather and the look of the sky remain through all of them what are customarily associated with Westerly winds.

Similarly, the wind will often blow persistently from some point of East, fluctuating between South-east for fouler weather, and North-east for finer weather, and back again, with many variations, for several weeks, during which the predominant features of the weather are always characteristic of East winds. The frequent recurrence of particular types of weather at particular seasons of the year is also a matter of common observation; the North-east winds of March, the cold North winds of the middle of June, and the wet West winds of September, are well-known instances.

While examining a large number of synoptic charts for the year 1865, the author was struck with the fact, that relatively to Europe, the general position of the great areas of high pressure frequently remained constant for a lengthened period. Further examination showed that the constancy of these positions coincided with persistency of types of weather similar to those above mentioned, the fluctuation of type being due to the passage of cyclones, while the local variation depended on the position of the cyclone centre and on the innumerable local conditions which modify any general type.

The author now lays the result of this investigation before this Society.

The bases of this investigation are principally the French *Atlas des Mouvements généraux de l'Atmosphère* for 1865, which refers to the weather of Europe and the North Atlantic, from the Equator to a line drawn obliquely from Newfoundland to the North Cape of Norway; and Hoffmeyer's Charts, extending over Europe, Greenland, the United States, and the Atlantic down to about 40° North latitude. The types may be considered as applying generally to Europe, while the details of weather are applicable only to Great Britain. Over the above areas the distribution of atmospheric pressure presents certain constant features, namely—

1. An Equatorial belt of nearly uniform low pressure.

2. A Tropical belt of high pressure rising at intervals into great irregular elevations or anticyclones.

3. A Temperate and Arctic region of generally lower pressure, but in which occasionally areas of high pressure appear for a considerable period.

The Equatorial belt constantly covers the Sahara and the Amazon valley, and always narrows over the Atlantic at about 30° West longitude, where it often does not reach higher than 10° North latitude. The shape and depth of this area are tolerably constant.

The Tropical belt comprises a region of high pressure, rising at variable intervals into great anticyclones; these anticyclones are usually then longest in an East and West direction, and often rise into two or more heads. Their position is generally variable, with the exception of one, which is always found over the central Atlantic. This anticyclone forms a very important factor of the weather of Western Europe, and will be constantly referred to as "The Atlantic Anticyclone." Its extension South and West is tolerably constant, while towards North and East it is variable, sometimes rising as far as 60° North and stretching over Great Britain and Continental Europe.

Cyclones are rarely if ever formed to the South of this anticyclone; sometimes they have their origin on its South-west side, when they work round the anticyclone, first towards the North-west, and then towards North-east. These are the West India hurricanes.

The North side of the anticyclone is the birthplace of innumerable cyclones of every size and intensity, which invariably move towards some point of East.

Cyclones are also occasionally formed on the South-east side; these either work very slowly round the high pressure to the South-west, or else leave the anticyclone and go Eastward.

The Temperate and Arctic region extends from the tropical high pressure belt to the pole. The pressure though ordinarily low, is perpetually fluctuating by reason of the incessant passage of cyclones; yet occasionally persistent areas of high pressure appear in certain portions of it.

With reference to Western Europe, there are at least four constant types of weather:—

1. The Southerly, in which an anticyclone lays to the East or South-east of Great Britain, while cyclones coming in from the Atlantic either beat up against it, or pass towards North-east.

2. The Westerly, in which a tropical belt of anticyclones is found to the South of Great Britain, and the cyclones which are formed in the central Atlantic pass towards East or North-east.

3. The Northerly, in which the Atlantic anticyclone stretches far to the West and North-west of Great Britain, roughly covering the ocean. In this case cyclones spring up on the North or East side, and either work round the anticyclone to the South-east, or leave it and travel rapidly towards the East.

4. The Easterly, in which an apparently non-tropical anticyclone (or one disconnected with the tropical high-pressure belt) appears in the North-east of Europe, rarely extending beyond the coast-line, while the Atlantic anticyclone is occasionally totally absent from the Bay of Biscay. The cyclones then either come in from the Atlantic and pass South-east between the two anticyclones, or else, their progress being impeded, they are arrested or deflected by the North-east anticyclone. Sometimes they are formed to the South of the North-east anticyclone, and advance slowly towards the East, or in very rare instances towards the West.

As an example of these type groups, subjoined are those of the first three months of 1865.

January 1st to 17th, Westerly type; 18th to 31st, materials insufficient; February 1st to 12th, Easterly type; 13th to 15th, Transitional; 16th to March 6th, Westerly type; March 7th to 12th, Northerly type; 13th to 21st, Easterly type; 21st to 27th, Northerly type; 28th to 30th, Transitional.

Notice will now be directed to the details of these types—first to their main character and seasonal modifications, together with the signs of intensity; and then as to how far the unit components of weather, such as cyclones, anticyclones, secondaries, &c. are modified by the type in which they occur; and finally, any signs of persistence or change of type will be indicated when possible.

Southerly Type.—In this type the Atlantic anticyclone extends very little to the Northward, while a large area of high pressure covers the East and South-east of the United Kingdom.

The North Atlantic is occupied by a persistent area of low pressure in which cyclones are constantly being formed; these beat up against the high European pressure, and either die out or are repelled.

Sometimes, especially in summer, small cyclones arising on the Easterly

side of the area of depression pass rapidly near the British coasts in a North or North-east direction. In either case it is somewhat rare for the centre of a cyclone to reach over these Islands, so that generally Great Britain is under the influence of the rim or edge of either a cyclone or anticyclone.

At other times the Atlantic low pressure extends over Great Britain, driving the high pressure eastwards, without forming any definite cyclone. In this case, the indications are for tolerably fine weather and little wind, with a very low barometer, a condition which often excites remark.

This type of weather occurs at all seasons of the year, but is most common and persistent in winter; in fact, the warmth or otherwise of the winter principally depends on the number of days this type prevails.

In winter the cyclones are usually large, but in summer the general depression of the Atlantic is much less pronounced, while the cyclones are smaller; their centres progress further Eastward, and the gradients are less steep. The weather in them is not so dirty, though the air is always close, and the sky harder than in winter.

The temperature of this type is always high, this being partly due to the prevailing Southerly winds; and as the cyclones die out, the slight degree of cold which follows is very noticeable.

Sometimes a portion of the Russian anticyclone stretches over Great Britain, and in winter gives rise to white frost of short duration.

The wind in this type is remarkable for its steadiness and absence of gustiness, except when the intensity is extreme; and for various reasons the gales of wind do comparatively little destruction either on sea or land, considering their force and duration.

The peculiarity of cyclones of this nature, besides their great size, is that the steepest gradients usually occur to the East or South-east of the centre, where, as it were, they form a region of great intensity both of wind and weather; but inside this belt the sky is only cloudy, and the air tolerably cool, while the wind is always light.

In this respect they show a marked contrast to the typical cyclones of the Westerly class, where the rain and cloud are to a certain extent symmetrically disposed around the centre. The rear of the cyclones is sometimes so ill-defined, that they might almost be classed by themselves and called hemicyclones. The wind is often very slightly incurved, especially when the cyclone is about to be repelled, or is of large size.

There is a marked peculiarity in the diurnal variation of cyclones belonging to this order during the winter months. In the West especially, the worst weather, with wind and rain, occurs from about 2 h. to 6 h. a.m., and when the intensity is very great gives rise to a peculiar class of thunderstorm in the early morning on the West coasts of Ireland and Scotland, which does not occur in other parts of the country.

The author has been unable to determine whether this is a true diurnal variation, or whether it is not related to the incoming of cyclones from the Atlantic being influenced by the time of day; for this morning intensity seems to be associated with a steepening of the gradients during those hours, which does not occur with true diurnal variation.

The secondaries of this type are almost always formed on the East or South-east side of the cyclones, and indicate rain rather than wind.

V-shaped depressions are not common, and they generally appear in the South-east corner of a cyclone. Under their influence, or that of a secondary in the same position, the isobars over Great Britain often form, roughly speaking, two sides of a square, running nearly East and West on the South side, with moderate gradients for West wind; and nearly North and South on the East side, with steep gradients for Southerly gales. The indications then are for a sharp Southerly gale, which quickly subsides as the wind shifts rather suddenly to West.

Anticyclones as a whole are never observed in this type, but the edge of the European anticyclone frequently stretches over Great Britain, when the indications would be for the radiation weather due to the season.

Straight isobars are common, trending from North-east to South-west, or from North to South. The weather associated with them, especially in winter, is often very warm and muggy, reeking with wet, and the sky is overcast, forming a great contrast to the hard sky which is noticed with straight isobars of other types. The signs of persistence are only those common to every type, as described hereafter.

Then as to signs of change. This type may merge insensibly either into the Westerly on one side, or the Easterly on the other, the latter change being usually the more abrupt; but it is not possible to give any detailed description of the symptoms of change.

To a single observer the sequence of weather in this type is very simple. As atmospheric pressure falls temperature rises, and the sky grows dirtier till drizzling rain sets in. The wind, from some point of South, having backed slightly, rises in velocity till the barometer has reached its lowest point; but as soon as pressure has begun to increase, the wind veers a little, and gradually falls, the air becomes cooler, and the sky begins to clear; but it rarely becomes hard, or contains firm *cumulus*.

Next day perhaps the same sequence is repeated, varying only in intensity but not in general character, and this sequence often lasts for weeks at a time.

All the above phenomena are evidently due to the passage of the fragments of extensive cyclones over an observer; but in this type sometimes after the barometer has fallen fast with very bad weather it suddenly becomes stationary, the weather improves and the wind falls light; and then after several hours the pressure slowly begins to increase, the air becomes cooler, and the weather completely clears. This is due to a ring of steep gradients passing the observer, and leaving him in the centre of a very large cyclone which gradually disperses.

Now, as to Forecasting, it is only intended in this Paper to allude to the subject in so far as may illustrate the value of a classification of weather into types for that purpose.

It is evident that when a persistent spell of this type is recognised as having set in, the general character of the weather and direction of the wind

are at once indicated, so that all that is necessary for storm warnings, is to watch for signs of the intensity becoming so great as to give rise to a gale.

An inspection of the illustrative charts will show that the area involved is so large, that it is hopeless to trace the cyclones as a whole, but that usually within the area of the British telegraphic reports, and always within the area of the large charts, there are localities to the East or North-east where the pressure is steady, while over the Atlantic great variations occur, and it is, therefore, necessary first to try and discover the area of steady pressure, and then to keep a sharp look-out for any rapid fall of the barometer over the West coast of Ireland, which would produce steep gradients and their associated gales. When once a fragment of a ring of steep gradients is formed, its progress Eastwards must be traced by telegraph, and watch must be kept that there is no giving way of pressure over Scandinavia. Since the rate of progress of the steep gradients is usually slow and pretty regular, and since, as has been shown above, the direction of the wind with the general character of the weather is subject to little uncertainty, gales of this type are practically forecasted with almost greater success than any other class.

The following is an illustration of this type of weather :—

In figs. 1, 2, 3 and 4 are given synoptic charts over a large area for the four days, February 25th to 28th, 1874. In all of these, pressures of 29·9 ins. and under are marked by dotted lines, to indicate the broad features of the distribution of high and low pressure.

In each of them the Northern edge of the great Atlantic anticyclone is seen near the Canary Islands or coasts of Portugal, and in all the pressure is high over Russia, but low over the Atlantic. On the 25th a portion of a cyclone, so large as nearly to fill the whole North Atlantic, is seen affecting the British Islands ; on the 26th, the cyclone centre seems to have moved somewhat towards the East, and to have become deeper, giving rise to steep gradients with heavy South or South-west gales in Great Britain, while the Russian anticyclone has retreated a little to the East.

The details for that day at 8 a.m. are shown in fig. 5, where the most noticeable features are the connection of the worst weather and strongest wind with the rim of steepest gradients, so characteristic of this type.

On the 27th, the area of high pressure over Finland remains stationary, but the barometer has risen no less than 0·4 in., while the cyclone has shifted its course towards Iceland, though the rim of steepest gradients has moved Westwards towards Norway, and a group of secondaries has formed over Western Europe. Over Great Britain the wind has moderated, but the weather remains unsettled, owing to the presence of the secondaries.

On the 28th the cyclone has disappeared in the Arctic ocean, and while the Finland anticyclone has advanced, the secondaries over Western Europe have much developed. At the same time a new cyclone has formed in the Atlantic with an increase of pressure in the Atlantic anticyclone; and a similar sequence of weather will follow as long as the two areas of high pressure maintain the same relative positions.

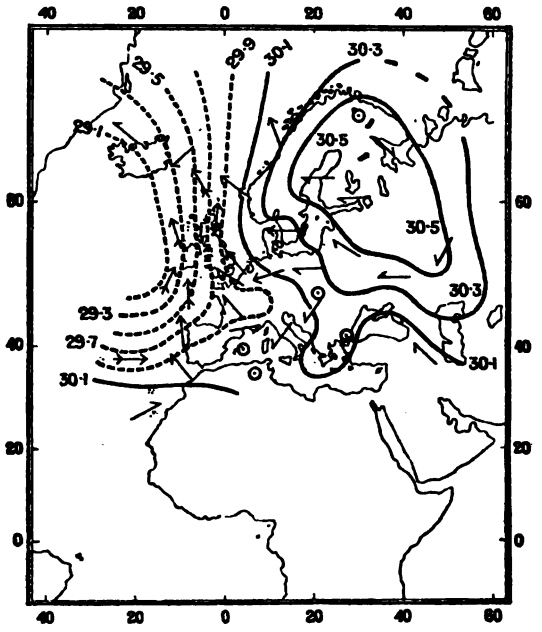


Fig. 1.

February 25th, 1874.

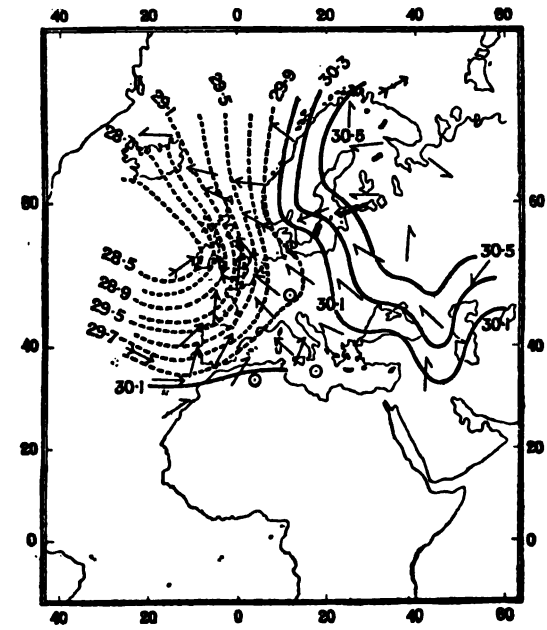


Fig. 2.

February 26th, 1874.

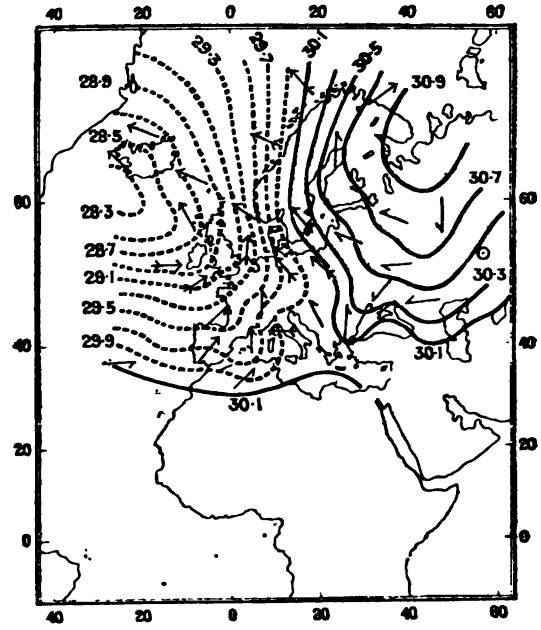


Fig. 3.
February 27th, 1874.

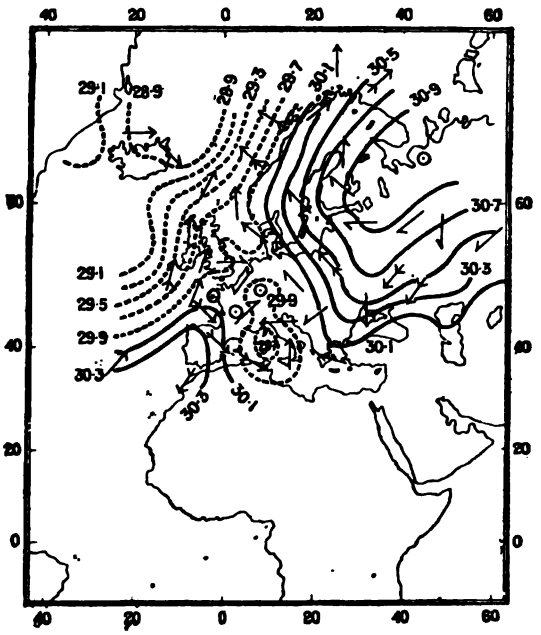


Fig. 4.
February 28th, 1874.

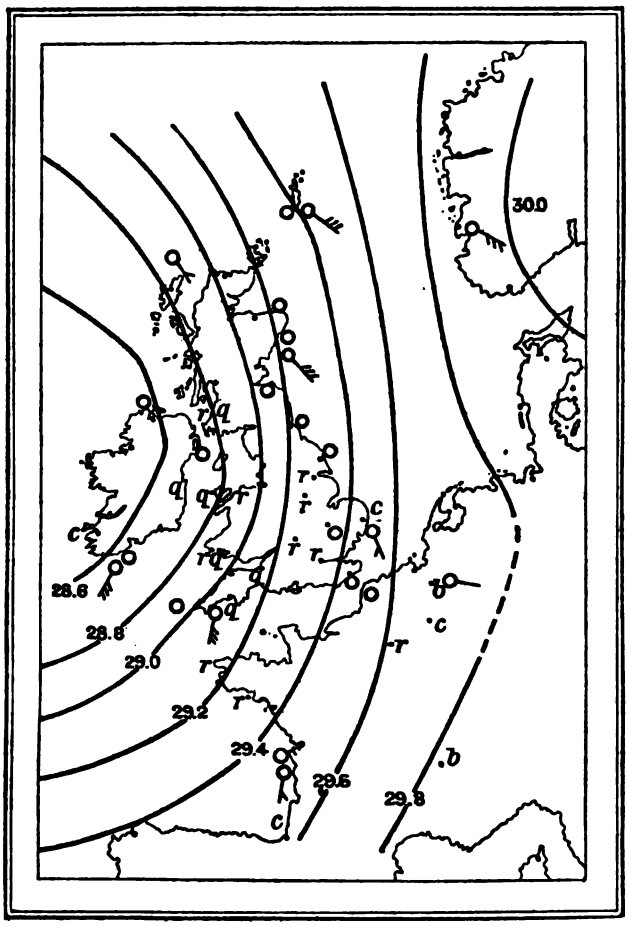


Fig. 5.

February 26th, 1874.

The Westerly Type.—In this type the tropical belt of anticyclones is constantly to the South of Great Britain, and the pressure to the East, West, and especially the North, comparatively low. Under these circumstances cyclones are developed on the North side of the Atlantic anticyclone, which roll quickly Eastwards along the high-pressure belt, usually dying out after they have become detached from the Atlantic anticyclone in their Eastward course. Their intensity, and consequently the weather they produce, may vary almost indefinitely. When the cyclones are formed very far South, so that their centres cross Great Britain, and are of moderate size, the intensity is usually great, and severe well-defined storms with sharp shifts of wind are experienced. These occur most frequently in spring and autumn, and are the most destructive storms which occur in Great Britain.

Another intense form is a series of small, short-lived, quick-moving cyclones, and numerous secondaries, without very steep gradients, during which the indications are for rainy, broken weather, rather than for storms. This type is more common in summer, but rare in winter.

In another modification, while the pressure is low to the North, and the isobars run nearly due East and West, the whole of the Arctic area of low pressure surges Southward, with an exceedingly ill-defined cyclone, bringing a rim of steep gradients along the edge of the Atlantic anticyclone, and across Great Britain, in a manner analogous to the phase of Southerly type before explained. The indications then are for rain and Westerly gales with very little shift of wind. This phase belongs almost exclusively to the winter months.

But the commonest modification at every season, and that which forms about seventy per cent. of our weather, is when the intensity is moderate, and the cyclone paths are so far to the North of the British Islands that the wind merely backs a point or two from South-west as the cyclone approaches, and veers a point or two towards the West as the cyclone passes, the general direction of the wind being between South-west and West, without rising to the strength of a gale, while rain is moderate in quantity.

Sometimes in summer a prolongation of the Atlantic anticyclone covers the Southern portion of Great Britain, and cyclones of small energy and passing far North just influence the Northern counties. Then the intensity is too small to develop rain, and only produces cloud in the middle of the day, so that fine dry weather is indicated, which when very prolonged may give rise to drought.

The general temperature of this type is about the average of the season, a little warmer in front of the cyclone, and a little colder in the rear. In winter, however, a great prevalence of this type gives an open season, as the high wind prevents frost, unless the cyclones are so far North that the influence of the Atlantic anticyclone is felt.

In summer, on the contrary, if the type be intense the temperature is below the average, from the excess of cloud hiding the sun.

Another important consideration as regards temperature is the normal cyclone path. The difference of temperature just North and South of a cyclone-centre is very marked, so that when the cyclone passes further South than ordinary, the temperature of the region lying between the usual and actual paths is greatly lowered. The value of this consideration will be seen further on in this Paper.

In cyclones of this nature the steepest gradients are generally found on the anticyclone side at a distance from the centre, increasing with the intensity of the cyclone. The isobars are mostly slightly elliptic. Unfortunately the major axis of the ellipse gives no certain indication of the cyclone track, though when it greatly exceeds the minor axis, it is generally parallel to that track.

When the cyclone paths are further South than usual, it is a valuable sign of intensity of the type.

The wind is, as a rule, considerably incurved in the whole front of the cyclone, while in rear it is nearly parallel to the isobars. In many cases the wind shifts suddenly after the passage of the trough, especially on the Southern side of the cyclone's centre. In well-defined cyclones the rain and cloud areas lie symmetrically round the centre, but when very large, the rain is found along the rim of steepest gradients, while the centre may be only cloudy.

The diurnal variation of both wind and weather is normal. The Eastward translation of these cyclones is more rapid than in any other type, and their paths are longer. In the rare cases of cyclones crossing the Atlantic they belong to this type.

The secondaries of this type are almost exclusively formed on the South-east edge, or the Southern prolongation of the trough. They are a mark of great energy, and often disturb forecasts by their sudden appearance. They indicate rain, with thunder in summer, rather than wind.

V-shaped depressions are of most frequent occurrence during this type. They are almost invariably developed in the Southern prolongation of a cyclone trough, and indicate rain, with thunderstorms in summer, but rarely strong wind.

These V-shaped depressions present many points of great interest; in front of them the wind is from South-west, while in their rear it is from North-west. The continuous rain associated with them is almost exclusively in front of the trough, so that the passage of the trough over an observer is accompanied by a sudden change of both wind and weather. But the most interesting feature is their relation to cyclones; for while a cyclone has as it were a double symmetry, namely, one set of phenomena symmetrically disposed in front and rear of the trough; and another set, such as wind and rain, symmetrically arranged round the centre; a V-shaped depression has only one line of symmetry—the trough, to the front and rear of which alone both wind and weather are related.

The anticyclones occurring in this, the Westerly, type, are generally longest in an East and West direction, and one or more heads, more or less circular, are often formed locally. Their temperature is due to the radiation of the season, that is, cold in winter, and hot in summer; but these are usually warmer than anticyclones of the Northerly or Easterly types at any season.

To this type also belongs a peculiar class of warm, cloudy anticyclones, which seem to be associated with cyclones passing to the far North, but which have not yet been investigated.

The wedge-shaped area of high pressure between two cyclones is characteristic of this type, and is an almost unfailing indication of fresh bad weather. The immediate forecast is for fine weather in front, changing rapidly to rain as the new cyclone comes on. In winter there is often a sharp white frost, or if the wedge of high pressure is large enough to last a whole day, the well-known "pet day," of popular weather lore, supervenes.

Straight isobars are signs of unsettled weather in this, as in every other, type, but the sky with them is much harder than in the Southerly type.

Now as to signs of persistence. It has been shown that a wedge of high pressure indicates a continuance of the same sequence of cyclones. Many years ago, Mr. Buchan observed that when the temperature does not fall as much as usual in rear of a cyclone, another almost immediately follows; while M. Marié-Davy has pointed out, that when the cyclone centre moves along a V-shaped path, that also indicates a new cyclone with fresh bad weather.

Then as to signs of change. This type merges almost insensibly into the Southerly, but on the other side the change to the Northerly is abrupt. Unfortunately, no certain symptoms can be detailed formally, but the appearance of a secondary on the South-west or West side of a cyclone ordinarily precedes an irruption of the Northerly, while a very deep surge sometimes precedes the commencement of the Easterly type.

To a single observer, the principal peculiarity of this modification lies in the variable wind and weather. In the Southerly type an observer only gets as it were the front of a series of cyclones, while in this type he gets the characteristic weather of both front and rear.

In the former condition the worst weather is always in front; while in this the worst often occurs in the rear, after the pressure has begun to increase. In some of the synoptic charts it will be seen that there is a small area of steepest gradients to the South-west of the centre, where the high pressure closes up in rear of the cyclone. In this type too the characteristic squall during the passage of the cyclone's trough is most frequently observed.

In forecasting during the prevalence of this weather the chief difficulty arises when the intensity is so great that the cyclones form and disperse rapidly, or two or three secondaries merge into one big cyclone. In these cases, though the general indication is for broken weather, the details for any one locality cannot be given with certainty. Another case of doubt, over a small area, arises when a well-defined cyclone is approaching Ireland so far South that its centre will cross Great Britain. The difficulty then is, that though the wind and weather to the North and South of the centre can be prognosticated accurately, there is always considerable uncertainty as to the exact course of the centre, so that the belt of country between the track expected by the forecaster and that actually taken, may receive a forecast exactly opposite to what occurs.

Without attempting to discuss the question, the author would like to make the suggestion that if the difference of the barometer for one hour, either before or after the 8 a.m. report, was telegraphed to London, the forecaster would then have, as it were, the differential of the cyclone's motion before him, by which means a better estimate might be formed for the future than by considering the relation of the last 6 p.m. chart.

An example of the Westerly type occurred in the period from February 26th-28th, 1865; it may be taken as illustrating that kind of intensity which produces broken weather without very steep gradients (figs. 6-11). On the morning of the 26th the Equatorial low pressure occupied its usual place, into which the North-east and South-east Trade winds blew; an area of high

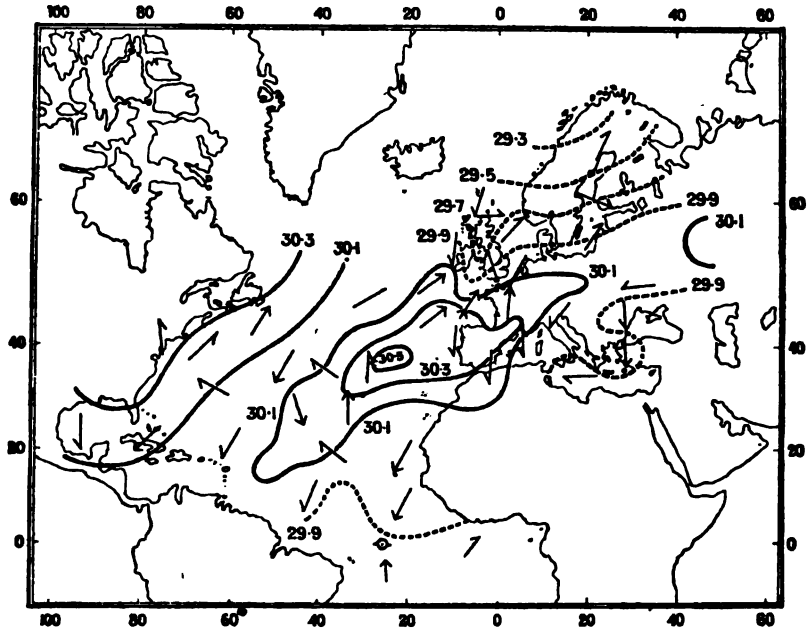


Fig. 6.
February 26th, 1865.

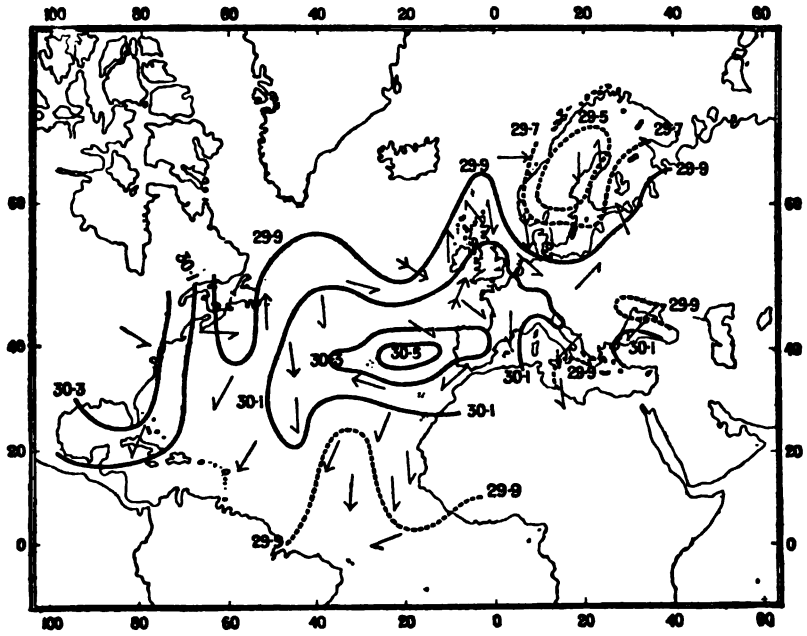


Fig. 7.
February 27th, 1865.

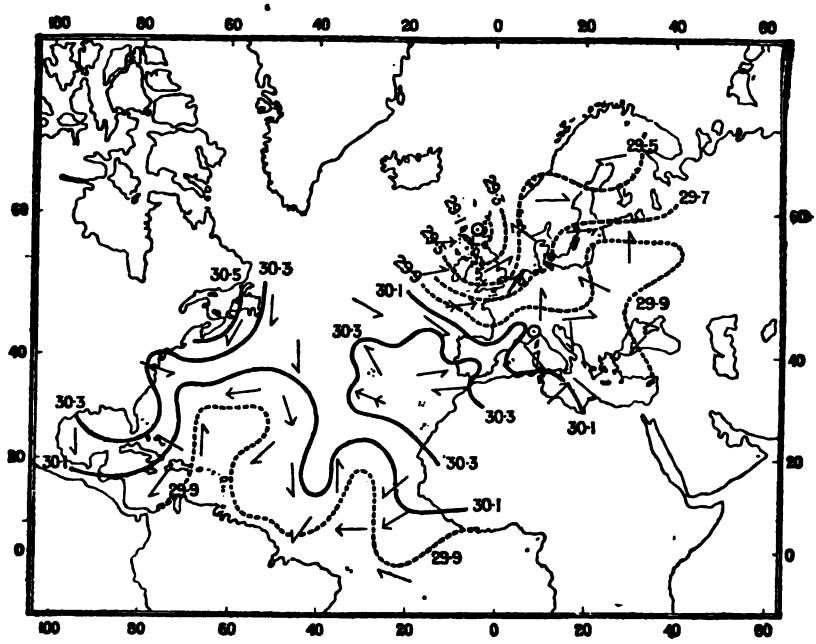
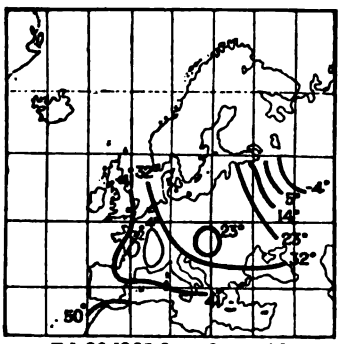


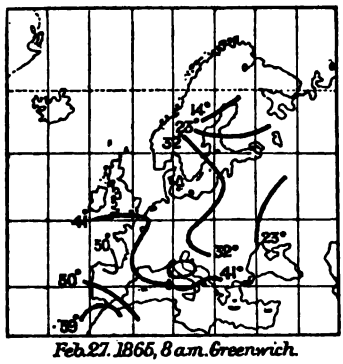
Fig. 8.

February 26th, 1865.



Feb. 26. 1865, 8 a.m. Greenwich.

Fig. 9.



Feb. 27. 1865, 8 a.m. Greenwich.

Fig. 10.

pressure covered the United States; the Atlantic anticyclone stretched from the West Indies to Poland, its head of highest pressure being near the Azores; the edge of another anticyclone was near Moscow, but it is not shown in the chart; the fragment of a cyclone skirted the North of Norway; there was one small secondary near Denmark; and a V-shaped depression lay over Great Britain. Further Westward, three inflexions are found on the North side of the Atlantic anticyclone.

Feb. 28. 1865, 8 a.m. Greenwich.

Fig. 11.

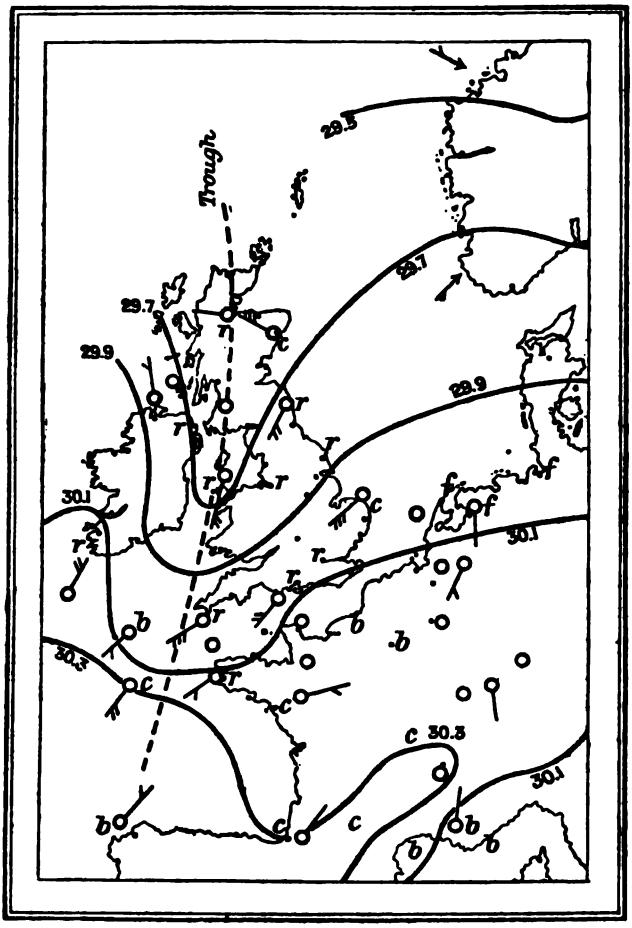


Fig. 12.

February 26th, 1865.

The temperature was low over Russia, increasing towards the West, where the isothermal of 41° projected upwards over England in front of the V-shaped secondary. The winds to the North of the Atlantic anticyclones were generally Westerly, modified by their position relative to the cyclones and secondaries; and moderate to strong in force.

The weather was rainy or overcast at almost all the British stations, owing to the secondary (fig. 12).[1] Since this chart is for the same day of the year and same hour as fig. 5, the diurnal and seasonal variations are completely eliminated, so that the difference of weather is solely that due to the different shapes of the isobars.

On the 27th the positions of the Equatorial low pressure and the Tropical high pressure are but slightly changed, but the cyclone over Norway has descended towards the South-east, partly by amalgamation with the V-shaped depression, while the secondary observed before over Denmark still appears over the Baltic. Great Britain is covered by a projection of the Atlantic anticyclone, forming the wedge-shaped projection of high pressure so characteristic of an advancing cyclone in this type. The three inflexions to the Westward have merged into two, and increased in intensity. The temperature (fig. 10) in Russia has risen, under the influence of the Norwegian cyclone, while in Great Britain the isothermal of 41° has retreated to the line of the Channel from radiation within the wedge-shaped area.

The winds still retain their modified Westerly set, while the weather over Great Britain is either clear or slightly clouded.

On the morning of the 28th the Equatorial low pressure, over the centre of the Atlantic, has fluctuated considerably, and an inflexion appears in it over Bermuda, which by next day developed into a cyclone traversing North-east. High pressure still covered the United States, and had advanced over Newfoundland; while the Atlantic anticyclone, much diminished in size and height, still had its centre near the Azores. The high pressure over Russia had disappeared; the Norwegian cyclone had moved on to the White Sea; while the depression noticed the previous day over the mid-Atlantic had developed into a cyclone of considerable intensity, with its centre over Scotland, accompanied by a group of secondaries. The wedge in front of the cyclone had advanced to Norway. The temperature (fig. 11) over Russia had much decreased, from the absence of the Norwegian cyclone, while the isothermal of 41° was projected Northward over Great Britain in front of the new cyclone. The winds still retained their modified Westerly direction, but were much increased in force over Southern Britain owing to the steeper gradients. The weather was rainy in the English Channel, and on the Western Coast.

Considering all the charts given in this Paper, two points may now be mentioned as suggesting lines of research which may some day be available for assisting the solution of the great problem underlying all forecasting—

[1] The weather symbols in this chart are only partially correct, as the observations are not all truly synchronous.

the determination of the motion of any existing system of pressure distribution.

Figs. 9, 10, 11 indicate the isothermal changes over Europe for three days. The broadest features of changes of temperature, due to change of wind or radiation, are in general sufficiently obvious, but in others they are inexplicable. The author has shown in a Paper *On the Heat and Damp which accompany Cyclones*,[1] that in an ordinary cyclone of the Westerly type, a patch of heat is developed to the South or South-east of the cyclone and moves along with it; and also that when a cyclone impinges on, or is diverted by, an anticyclone, there is also a development of heat, which cannot be attributed to either wind or radiation; while a peculiar class of warm anticyclones has already been alluded to in the present Paper. It seems almost certain that when the difficulties surrounding the treatment of the subject are surmounted, much information as to the course or presence of distant cyclones will be obtained by studying the position and shape of the isothermals. The seasonal variation would probably be best allowed for by taking the same day of different years, as in this Paper.

The other point refers to the relation of cyclones to anticyclones. It is evident from the charts for the Southerly type, and those for the Westerly type, that the relation of cyclones to what may be called the "generating" anticyclone in the Atlantic is very different from the relation to what may be called the "deflecting" anticyclone against which a cyclone impinges. In the former case, a small depression between two wedges easily developes into a well-defined cyclone, while in the latter no wedge appears in front of the cyclone, but the two circulating systems seem to collide and develope very bad weather near their junction. The relation of the wind direction and weather, in connection with the position of the cyclone centre and the adjoining high pressure, also varies greatly, according as the high pressure belongs to the generating cyclone or otherwise. When the Easterly type is discussed, attention will be directed to cyclones generated by a non-tropical anticyclone over Northern Europe, which present some points of similarity with others of dissimilarity to those generated in the Atlantic; but enough has now been said to show the importance in forecasting of distinguishing the generating from the deflecting anticyclone, though the full value of the difference has not been worked out.

The discussion of the Northerly and Easterly types must be reserved for a future occasion; but the author will now describe some phenomena which are of the utmost importance, and show in what the value of a classification of weather into types consists, with the terms used to define them. These terms, as well as such expressions as the "collision or repelling" of cyclones, must be taken merely as word symbols to represent phenomena seen on synoptic charts, and must not be taken too literally or physically interpreted.

In the first place, it must be clearly understood that although a well-defined

[1] *Quarterly Journal*, Vol. IV. p. 1.

type is very distinctive, there are a large number of transition forms, which it is almost impossible to classify. Thus the Westerly type merges almost insensibly into the Northerly, when the cyclones move towards the South-east; while the Northerly and Easterly frequently alternate for a day or two at a time.

Similarly the Easterly and Southerly, and still more the Southerly and Westerly, are often separated by imperceptible shades of difference; but in no case can one type merge into the one opposite to itself.

By the term "fluctuation," applied to types, is meant that though the weather may be good or bad, or vary in almost any manner, still a general character and sequence is discernible. This character is partly due to the high pressure keeping the same quadrant of the cyclones pretty constantly over the same place, and is partly impressed on each cyclone by the type. In fact, the leading idea of types is sequence, and it is from this that they derive their greatest value.

By the term "persistence" is meant, that in spite of the fluctuation, the general distribution of pressure on which the character depends remains constant, and in this property of types is found the explanation of many phenomena of weather, and of many popular weather prognostics.

For instance, a spell of cold weather in winter may be produced by the influence of either the Northerly or Easterly type; or if only for two or three days, may be caused by the wedge-shaped area of high pressure between two cyclones.

So also a drought may be produced by a persistent anticyclone, or else by the Westerly type when the intensity is slight and the cyclone centres are far North; while long-continued rain may occur with almost any persistent type, if the gradients be steep. These illustrations show another value of type groupings, for if the real test of identity of weather be that of being of the same type, and not the recurrence of any one quality, it will be possible to explain many apparent discrepancies in the results of statistical investigations, which of necessity can only deal with one function, such as heat, cold, rain, &c.

Then as to weather prognostics. It is a well-known saying, that "When grouse come down into the farm-yards it is a sign of snow." The birds are driven down in search of food by the excess of snow already existing on the moors, and so far the prognostic would refer to the past rather than to the future; but by the principle of persistence, the type which has already given so much snow may be expected to continue for some time, and therefore more snow may be expected. In Germany there is a proverb, "Fresh snow, fresh cold."

Similarly the prognostics, "When a river like the Tweed rises without any rain having fallen," or "Irregular tides are signs of rain," have a significance for the future; for though both are caused by past bad weather at a distance, yet the persistent type will almost certainly sooner or later bring more bad weather over the place of observation.

On the same principle the prognostic "Breakers in-shore without wind

are a sign of storm " holds on the East coast as well as on the West, but for a different reason. On the West coast the breakers have sometimes run on ahead of the cyclone which raised them, but on the East coast this does not occur, as practically all cyclones move towards some point of East. Nevertheless, though the storm which raised the waves has never affected the place where they occur, still it is extremely probable that another one of the same series will do so, and therefore the prognostic is good, though less certain than on the West coast.

By persistence also is explained what is termed " a feeding storm," or a " laying storm." In winter, when snow falls in fine flakes, especially with a North-east wind, it is called a " feeding storm," since it is only premonitory of a spell of frost and snow. This is true, because the fine snow comes usually with the first small cyclone of a persistent Northerly or Easterly type, whereas a heavy fall of snow in large flakes may occur in rear of a Westerly cyclone, if sufficiently intense.

It is also manifest that the principle of persistence has an important bearing on forecasts. Unfortunately, though such types are common, it is not yet possible to define any certain indications of change from one to another. One sign of persistence may, however, be mentioned which rarely fails. Sometimes a type apparently fails for a day or two, but then is re-established with great intensity. When this occurs, its continuance for a considerable time may safely be predicted. For instance, with the Easterly type a small cyclone frequently passes rather far to the East, and the wind shifts to the South-west with increased warmth, but when this dies out the Easterly type is re-established in full force.

In these cases the appearance of the weather is sometimes very characteristic, for though the wind is West, the look is that of an East wind, and so obvious is this, that people say popularly " that the East wind has not gone yet."

By the term " intensity " is expressed the relative severity of the weather, and, roughly speaking, this is found by observation to be fairly measured by the steepness of the gradients. In forecasting, a knowledge of this element is of the utmost importance, for according to its intensity a cyclone may be accompanied by either a little rain and moderate breeze, or else by a violent storm. Hence the value of any indications of increasing or decreasing intensity, a few of which may be given here.

One valuable clue can be obtained by watching the " surges " of the atmosphere; that is, those great alterations of pressure overriding both cyclones and anticyclones, and which are shown by a change of level and not by a change in the shape of the isobars.

In winter these surges sometimes amount to 0·5 in. or more, over an immense area, and in almost every case it will be found that the falling part of the surge increases, while the rising part diminishes intensity. These surges are often premonitory of a change of type.

Another form of intensity is essentially one of type, and refers to that sequence or tract of weather to which the term " broken " would be applied.

From synoptic charts broken weather is found to be either the product of small quick-moving cyclones, which only exist a very short time, or of frequent secondaries; in contradistinction to the weather produced by large low-gradient cyclones, moving slowly and lasting some days, which would be associated with more settled weather. The relation between these two kinds of intensity is analogous to the relation between single heavy gusts of wind and numerous short puffs, for both of these are signs of atmospheric disturbance, though proceeding from different causes. The explanation of a few prognostics is afforded by their dependence on intensity of type. For instance, sheet lightning in the early morning during winter, on the Western coasts especially, is a sign of bad weather, and so is the occurrence of hail squalls instead of rain squalls at the same season. Reference to synoptic charts shows that both are associated not only with steep gradients during their occurrence, but also that they take their place in a series of violent cyclones. Similarly all cyclones are produced by damp, but an intense cyclone by excessive damp, so that quantity of vapour becomes a rough gauge of intensity.

By "recurrence" of type is meant the tendency of certain kinds of weather to recur about the same season of every year. The following may be considered a preliminary, and very incomplete, list for Great Britain:—

January 14th to 20th, a great barometric surge.

February 7th to 10th, a spell of cold weather, associated with the Northerly type. This is the first of a series of six cold and three hot periods discovered by Mr. A. Buchan, and described by him.[1] The method adopted by him was to note the irregular flexures in the general sweep of the annual temperature curve. He found their recurrence so regular that he says, "during the last fifty years some of them appeared every year between the dates specified, and none failed to make their appearance on more than five years." He also noticed that during the cold periods the pressure was higher to the North of Scotland, and lower to the South, and that during the warm periods pressure was higher over Scotland than in places to the North.

March.—The proverbial East winds of this month are mostly due to the Northerly type, the winds being really North-east. The occurrence of equinoctial gales about the 21st of the month is a well-known fact. They are sometimes of the Easterly type, but more frequently of the Westerly.

April 11th to 14th.—A cold spell; Buchan's second period, which he has identified with the popular "weather saw" of the "borrowing days." These are three cold days, which March is said to borrow from April, allowing for the difference of the old and new style of reckoning the calendar.

May 9th to 14th.—A cold spell; Buchan's third period. This is the most celebrated of the cold periods, as it occurs over the greater part of Europe,[2] and has been the subject of many wild theories. The Saints to whom these days have been dedicated in the German Calendar have been popularly called

[1] *Journal of the Scottish Meteorological Society*, Nos. XIII. XIV. and XVI.

[2] For some interesting details see W. von Bezold, "Die Kälterückfälle, in Mai." *Abhand. K. Bayer. Akadamie der Wiss.* II. Cl. XIV. Bd. II. Abth.

"the frost Saints." This cold spell is also known as "Mendler's cold days" from the name of an investigator.

June.—A cold spell in the second or third week is associated with the Northerly type.

June 29th to July 4th.—A cold spell; Buchan's fourth period.

July 12th to 15th—A warm period; Buchan's first.

July 15th.—St. Swithin. The popular legend of this Saint, and other rainy Saints like St. Médard, receives an easy explanation from synoptic charts. Roughly speaking, the weather at the end of July is influenced by one of two types; either the Westerly of considerable intensity, which would be rainy, or the Northerly type, which would be dry. If, then, there is either a rainy or a dry spell about the 15th, similar weather may be expected to last for some time after, if not for forty days.

August 2nd to 8th.—A wet period; the "Lammas floods" of Scotland. 6th to 11th.—A cold period; Buchan's fifth. 12th to 15th.—A hot period; Buchan's second.

September.—The Easterly and Northerly types are rare during this month; the equinoctial gales are almost invariably of the Westerly type. About the 30th a fine period is experienced for a few days, the "Indian summer" of North America.

October.—About the second or third week a spell of the Easterly type of moderate intensity is common.

18th.—A fine quiet period about this time, "St. Luke's summer."

November 6th to 12th.—A cold spell; Buchan's sixth, associated with the Northerly type. The 11th is "St. Martin's little summer," popularly considered in the Mediterannean to be a period of warm quiet weather. About the 12th to the 15th a great atmospheric surge.

December 8rd to 9th.—A warm period; Buchan's third.

The question now arises, How far the knowledge of recurrent types can be utilised in forecasting? On a future occasion the author hopes to be permitted to lay before the Society a comprehensive view of the whole subject of meteorological periodicities; but the result only can be stated here, that though the forecaster is not justified in stating that any period will occur absolutely, still when about the time of its usual recurrence the synoptic charts show signs of the expected type, then the forecasts for a few days ahead can be issued with greater confidence. For instance, suppose that about the 6th of November the charts begin to show traces of the Northerly type, then, but not before, there would be good grounds for saying that a period of cold weather, which usually occurs at this season, has already set in, and may be expected to last for five or six days; the forecaster being thus enabled to issue a much longer forecast than can as a rule be safely attempted.

The author believes that the greatest assistance a forecaster could have would be a file of all available charts of past years for the day under consideration. He has tried the method for a few days at different seasons of the year, and the results are certainly very curious, and show that the trials are worthy of being conducted on a much larger scale.

It may be remarked that though the recurrent types here given apply in detail only to Great Britain, yet in the main they pertain to the whole of Western Europe, and that the principle of recurrence holds all over the world.

In conclusion, the author will merely allude to another use of type grouping in handling certain cosmical and geological questions, such as to the influence of changes in the distribution of land and water on climate.

From the illustrations and description of the position of the leading areas of high and low pressure, it is evident that they are mainly controlled by the areas of land and water. Thus, when over the Atlantic pressure is high, that over Russia is low; while when pressure over Europe is high, over Iceland it is low.

As a single illustration of the method of applying these principles, take the warm winters of Western Europe, which are due to the prevalence of the Southerly type, produced by the high pressure over Northern Russia and Siberia. If, then, Siberia were again submerged, as it has been in recent geological time, this high pressure would disappear, the Westerly type would most probably become more frequent, and the climate of Great Britain would certainly become colder.[1]

Similarly, the problem of the effect on European climate of the submergence of the Sahara might be attacked, though the conclusion is not so obvious.

The principle of type holds all over the world. The seasons in the tropics are the product of the variable position of the equatorial low-pressure belt, which has only an annual change. The nature of the Trade-wind region will be readily seen from an inspection of figs. 6, 7 and 8, where the fluctuating, but persistent, character of the Southern side of the Atlantic anticyclone is very obvious.

In the temperate region there seems evidence that every country has its characteristic types analogous to those that have been described for Europe. For instance, in the United States one of the commonest types is when the Atlantic anticyclone stretches up to Newfoundland, skirting the coast line; while a series of cyclones beat up against it and die out.

The results of this Paper may be summarised as follows:—

It is the tendency of weather all over the Temperate Zone to occur in spells, associated with certain types of pressure distribution.

In Great Britain there are at least four persistent types—the Southerly; the Westerly; the Northerly; and the Easterly. In spite of much fluctuation, one or other of these types often continues for weeks together, and tends to recur at the same date every year.

The value of the recognition of type groups is shown in the following ways:—

1. They explain many phenomena of weather, and many popular prognostics.

2. In some cases they enable forecasts to be issued with greater probability of success, and for a longer time ahead.

[1] In fact Woeikoff thinks that the depression of Siberia would reproduce the Glacial Epoch over Europe. See Woeikof "Gletscher und Eiszeiten." *Zeitschrift der Gesellschaft für Erdkunde zu Berlin*, 1881. 3 Heft.

3. Statistical results can be corrected by their means, by giving a true test of identity of recurrent weather, which no single item, such as heat, cold, rain, &c. can do.

4. They enable geological questions such as the influence of changing distribution of land and sea on climate to be treated in a more satisfactory manner than any other method.

DISCUSSION.

Professor ARCHIBALD considered the present Paper one of the best he had heard read before the Society. It was a distinct advance in the right direction, and foreshadowed what might be styled the Meteorology of the future.

In India he found the weather remarkably constant, comprising in reality only two great changes during the year, which occurred when the North-east monsoon was replaced by the South-west monsoon, and *vice versâ*.

In England the weather was popularly said to be constantly changing; but since he had returned from India he had been led to think that these changes were, after all, reducible to some plan, and that the rotation of winds and weather caused by the frequent passage of cyclones, and which constituted the leading characteristics of the variability of the accompanying weather, were constantly repeated, as the cyclones tended to move for long periods in one or other dominant direction; such direction being mainly controlled by the position of the larger areas of high and low pressure.

In this manner, the persistences of type mentioned by the author had been remarkably noticeable in the weather of the past three or four winters. The cold weather in the winter of 1878-9, for example, was readily traceable to the occurrence of a persistent area of high barometer off the West coasts of Great Britain, which caused the cyclones travelling across the Atlantic to come from a more Northerly point than usual, and so cause the prevailing winds to blow from a higher and colder latitude.

From the author's charts it was evident that definite types occurred in which the pressure was high over the Atlantic and correspondingly low over Russia, or the reverse; and he thought that by studying such types of weather over large areas, it might be possible in time to forecast the general style of the weather over certain districts for a month or more in advance, since although the number of cyclones had no apparent relation to such types, their course was closely related to the distribution of the larger and more constant areas of high and low pressure.

These large-pressure areas had been styled action-centres by M. Teisserenc-de-Bort, and it was probably periodical shifts in the intensity and position of three of these, namely the anticyclone in the North Atlantic, the cyclone near Iceland, and the high- or low-pressure area over Russia, which mainly produced all the more important changes of type and weather. The British Isles, unfortunately, presented an almost microscopic area for observation, and little could be done in the way of weather forecasting until means were found of ascertaining what was going on over the whole of the North Atlantic.

Mr. SCOTT said that to his knowledge Mr. Abercromby had been engaged in the study of weather types for several years, and that owing to continued ill-health he had been unable to complete the Paper at an earlier date. He welcomed the present instalment as an earnest of a fuller account of types, which would mark a decided advance in the science of the weather.

Captain TOYNBEE thought that the Paper pointed to the necessity of a knowledge of the disposition of barometrical pressure over a large extent of the earth's surface, before forecasting could be successfully carried out. In his work entitled *Etude sur les Tempêtes de l'Atlantique Septentrional, &c.* Captain Hoffmeyer had shown what could probably be done by means of telegraphic communication with Iceland, the Azores and Bermuda, in addition to the telegraphic communication with other countries which was already available. To put his views to the test, he collected back observations from these countries, and made forecasts of the wind and weather which he supposed had been experienced between America and Europe by four ships whose positions on each day during their passages had been supplied to him by the Meteorological Office; but no other data. The

results were found to be remarkably good when compared with the ships' logs. Captain Toynbee thought that if a judicious summary of the weather experienced by ships on their passage from these Islands to America were telegraphed daily from New York, it might be a great aid in forecasting European weather. He believed that this was the method followed by the *New York Herald*, and thought that the scientific value of its forecasts could be fairly tested if that paper would afterwards publish the data on which each forecast was based. He hoped that the data for the North Atlantic now coming in to the Meteorological Office would throw light on the subject. He was happy to say that the nautical world was joining heartily in the work, and that the Meteorological Office was receiving about 400 observations each day.

Mr. GASTER considered the Paper a definite advance on those previously published. It had, however, its disadvantages ; for as it dealt only with what might be termed the simpler types of weather, there was danger that those who read it might conclude that the forecasting of weather was a simpler matter than was really the case. Mr. Gaster then referred to certain complex conditions which had recently prevailed over North-western Europe, and showed how great were the deficiencies of material for any adequate discussion of such conditions. He next referred to the want of accurate definition which was common to papers of the sort now under discussion, and expressed a doubt whether any of those present could give definitions for the terms "secondary" and "subsidiary" as applied to depressions. After offering to the consideration of the Fellows some of his own views on this subject, Mr. Gaster drew attention to the fact that the motion of most of the depressions was dependent on the relative positions of the "persistent" high- and low-pressure areas, and that, consequently, the movements of these latter were deserving of greater attention than they had hitherto received.

Professor ARCHIBALD remarked that if, as Mr. Gaster suggested, and as seemed probable, primary cyclones were in reality subsidiary to larger and more permanent systems, the so-called secondary disturbances might henceforth be styled "tertiaries."

Mr. STRACHAN thought that the diagrams afforded evidence of the vast extension of observing progress in meteorology since the introduction in England of weather telegraphy by Admiral FitzRoy in 1860 ; and of the large amount of labour requisite to construct weather charts. As such charts accumulated, it became desirable to attempt some classification of weather conditions. The Paper showed that the author had energetically grappled with this problem, and had made a striking advance towards systematising phases of the weather. It was not to be expected that he had evolved a faultless scheme, or that he had succeeded in devising an altogether satisfactory nomenclature. Some of the terms used were perhaps objectionable. For instance, the phrase "persistency of type" had the ring of the algebraical law of the "permanence of equivalent forms." However logically the phrase might be used, it led up to absurdity. Köppen, for example, propounded, and pretended to prove, that the longer rainy weather prevailed, the greater the probability of its continuance ; but, of course, he deceived nobody with that transparent fallacy. Subsidiary disturbances in the atmosphere occurred for the most part within the boundary of large cyclones. The wind-systems of the globe were themselves cyclonic, and became the cradles of cyclones commonly so-called, in which again smaller cyclones were developed. These subsidiary storms often travelled at great speed, and came abruptly. Since weather telegrams were not sent to the Meteorological Office between 6 p.m. and 8 a.m., an interval of fourteen hours, there was time for a quickly progressing storm to make its appearance unannounced, as was the case with the storm of October the 24th. No indication of this storm was afforded by the 6 p.m. reports, but during the early morning it overlapped the South of England before the 8 a.m. reports were made.

Mr. SYMONS considered the practice of giving the paths of areas of low pressure, as now done in the Daily Weather Charts by dotted lines, a very useful addition. The forecasting of weather would be more reliable if telegrams giving weather information were received from the Azores, the United States, Newfoundland, and Iceland. With regard to the persistency of types of weather mentioned by the author, there was no possibility of knowing when the persistence would break off. The author's idea of having charts of the same day for several years back, as the chart which was being studied, appeared very good. He was glad the author had not overloaded the Paper with figures, but had given

general conclusions. It was to be regretted that the evening observations for the daily weather reports were not taken at a later hour than 6 p.m., as it allowed so long an interval to elapse between the evening and morning observations.

Mr. C. HARDING approved of any attempt at classifying according to type. He thought the time had come for some systematic arrangement in this direction, and considered the Paper valuable from this point of view. He did no consider that it dealt with anything new, probably that was not the author's intention. He considered the data upon which the conclusions had been drawn unsatisfactory; as nearly all the important changes came in from the Atlantic, it was necessary that in any such system of classification the conditions existing over that ocean should be well shown; but as a fact the material used was very poor in this respect. He indicated the value to be gained by a daily telegram from the United States Signal Service, giving the general conditions existing over America, or at least on its Atlantic coast. He would also obtain by telegram a report of the weather met with by fast steamers on their outward passage to America, not limiting their statements to the weather experienced to the West of Newfoundland, but giving a general digest of all weather experienced, with the view of determining, amongst other things, the behaviour of the permanent area of high pressure situated in Mid-Atlantic, since it doubtless materially influenced the persistency of type in the weather of the British Islands. He did not think that any proper attempt had been made to determine the effect of the depressions which crossed the Atlantic, on the barometer at the Azores, and suggested that a careful discussion on this head would probably throw considerable light on the weather of the British Islands.

THE METEOROLOGY OF MOZUFFERPORE, TIRHOOT, 1881. By CHARLES N. PEARSON, F.M.S.

[Read November 15th, 1882.]

IN the year 1881 the weather was generally propitious for agriculture; the rainfall, though collectively rather below the average, was evenly distributed, and all the principal crops were excellent.

January was cold, fine and clear. The mean of the minimum temperatures was unusually low, 41°·8; and white frost was noticed on the 13th, 14th, and 15th, the actual minimum temperature being 36°.

February was dry. Only one slight shower fell, on the 25th, in which ·02 in. of rain was measured. At the end of the month rain was wanted for the rubbi crops. The first half was colder than usual, and the latter warm with strong Westerly winds.

March was more unsettled than usual at this season. The rain was beneficial to the rubbi, though it did much damage to the mangoe blossom. A hail-storm occurred on the 4th, and thunderstorms with rain on the 19th and 26th. The month was cool, the extremes being 87° and 51°.

April was dry, and fairly cool till the last week, which was hot with strong winds. The maximum temperature was 103° on the 27th, 28th and 29th.

May was an average month, very hot on the 1st, 2nd, and 31st, the maximum temperature being 102° on the latter date. An unusually heavy fall of rain occurred on the 11th, 2·43 ins., and abundant falls on the 15th and 23rd; the total rainfall was 3·58 ins.

June was cooler than usual; the only day on which the maximum temperature exceeded 100° was the 1st, when it reached 101°. The rainy season proper set in on the 9th, considerably earlier than usual; but though there

TEMPERATURE AND RAINFALL AT MOZUFFERPORE, TIRHOOT, 1876-1881.

Month.	Temperature. Highest. 1876.	1877.	1878.	1879.	1880.	1881.	Lowest. 1876.	1877.	1878.	1879.	1880.	1881.	Mean Highest. 1876.	1877.	1878.	1879.	1880.	1881.
	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°
January	72	71	71	77	71	70	35	40	35	35	41	36	66·7	64·3	64·5	69·2	67·0	65·4
February	82	73	85	84	77	84	36	37	41	42	43	41	73·5	64·1	74·6	74·0	69·1	74·5
March ..	97	85	98	99	91	87	48	46	44	47	46	51	86·2	78·7	84·7	87·1	83·2	81·0
April	100	95	99	106	101	103	51	51	59	61	63	61	93·3	86·3	93·4	100·4	95·0	93·5
May	105	99	99	108	100	102	66	64	67	70	66	67	95·3	93·0	93·0	101·4	93·9	93·8
June	102	106	107	107	99	101	72	68	73	72	71	74	94·8	97·1	99·8	95·8	93·9	93·3
July	95	101	97	96	97	99	74	74	77	77	75	75	89·9	93·7	92·8	91·2	90·2	93·0
August ..	92	98	97	93	96	97	74	73	74	76	75	75	89·0	91·8	91·5	89·7	89·8	90·2
September	94	97	95	95	94	94	71	73	75	75	73	72	87·4	90·3	90·6	90·1	89·4	89·0
October ..	86	89	93	94	92	90	57	55	57	58	58	60	77·8	83·5	87·0	83·1	85·9	83·6
November	77	81	85	78	81	78	42	48	44	43	44	46	70·8	77·4	77·9	72·1	73·3	74·0
December	65	74	78	72	70	71	38	38	37	40	41	40	63·3	68·2	69·3	66·5	66·1	67·3
Year ..	105	106	107	108	101	103	35	37	35	35	41	36	82·3	82·4	84·9	85·1	83·1	83·2

Month.	Temperature. Mean Lowest. 1876.	1877.	1878.	1879.	1880.	1881.	Rainfall. 1876.	1877.	1878.	1879.	1880.	1881.
	°	°	°	°	°	°	In.	In.	In.	In.	In.	In.
January	42·2	45·2	44·0	43·0	46·4	41·3	·11	2·05	1·53	..	..	..
February	44·6	42·8	50·5	49·8	49·4	49·3	..	·95	·11	1·03	1·56	·02
March	55·4	55·0	55·5	56·0	61·1	57·4	·17	·25	·06	..	..	1·39
April	64·6	61·7	67·5	66·0	70·1	67·6	1·75	·25	·85	..	..	..
May	74·1	70·9	71·1	77·8	74·6	75·0	1·67	1·89	4·75	·78	2·88	3·58
June	77·6	78·3	80·5	78·9	78·6	78·4	5·17	1·78	3·30	17·14	2·59	7·02
July	76·5	77·7	79·8	79·2	78·1	78·9	5·43	9·31	11·22	17·62	15·62	6·98
August	75·8	77·8	78·5	78·3	77·8	77·6	14·59	2·91	7·77	5·39	15·81	9·74
September	74·6	76·3	77·7	77·7	76·3	76·5	23·01	2·50	5·99	14·08	1·50	10·42
October	63·9	65·3	69·9	70·1	70·6	68·4	5·74	5·95	·32	9·40	1·42	3·50
November	49·7	56·0	56·9	51·9	55·1	52·7	·05	..	·30	·05	·28	..
December	41·4	47·4	45·1	46·0	45·4	45·1	..	1·16	..	..	·01	..
Year	61·7	62·9	64·8	64·6	65·3	64·0	57·69	29·00	36·20	65·49	41·67	42·65

were frequent showers, the only heavy rain was on the 16th and 17th, when 8·98 ins. fell in forty-eight hours with little cessation. The total fall was 7·02 ins.

July was a hot oppressive month, and in some places the scantiness of rainfall gave rise to anxiety; frequent showers fell, but the total fall only reached 6·98 ins., the smallest amount for July since 1876. The maximum temperature reached 99° on the 14th.

The first part of August was also rather oppressive, and the rainfall light, but after the 17th rain fell nearly daily in heavy showers, and the total fall was 9·74 ins. The maximum temperature, 97°, occurred on the 17th.

September proved a seasonable month; a break in the rains with oppressive weather between the 4th and 16th was followed by two days of heavy rain (5·09 ins.) on the 17th and 18th, and showers to the end of the month. The total fall of rain was 10·42 ins. As this is the critical month

for the rice crop, the importance of this seasonable fall cannot be exaggerated, and prices fell to a lower point than had been known for many years.

October was also very seasonable. 8·50 ins. of rain fell between the 1st and 9th, principally on the 7th. After the 9th, fine settled weather set in, and continued.

November and December were likewise fine throughout without rain. The temperature was rather low about the middle of December, falling to 40° between the 14th and 17th.

The total rainfall for the year amounted to 42·65 ins., being about 10 ins. below the average, and nearly the same as in 1880; but in 1881 the fall was extremely evenly distributed over the six months from May to October.

The accompanying table gives the highest and lowest temperatures, the mean of the highest and lowest temperatures, and also the rainfall for each month for the six years 1876-1881.

Popular Weather Prognostics. By the Hon. Ralph Abercromby, F.M.S., and William Marriott, F.M.S.

[Read December 20th, 1882.]

The attempt to foretell the weather is not of recent date; the ancients carefully studied the sky and clouds, and endeavoured to predict the kind of weather that was likely to ensue; and a number of the popular prognostics of the weather of his time are recorded by Aristotle in his work *On Meteors*. In later times, our forefathers studied the weather, and as they had no instruments to guide them, they observed natural objects and noticed the appearances of the sky and clouds, and also the movements of animals, birds, plants, &c. Shepherds and sailors especially, being exposed to all kinds of weather, would naturally be on the look-out for any signs of a coming change, and after a time would begin to associate certain appearances with certain kinds of weather. A good deal of weather wisdom of the above character has been thrown into proverbs, trite sayings and popular verse; and we propose in the present paper to examine and explain some of these by the aid of the most recent discoveries of meteorological science.

A great advance has been made in Meteorology during the last twenty years owing to the introduction of daily synoptic charts of the distribution of atmospheric pressure, temperature, wind, rain, &c. From these it is evident that there is a distinct relation existing between the distribution of pressure and the direction and force of the wind, and the temperature and weather generally. A glance at a number of the charts shows that there is nearly always present either an area of low pressure, called a cyclone, usually having an approximately circular form, and, as a rule, moving in an Easterly or North-easterly direction; or an area of high pressure, called an anticyclone, also nearly circular in form, but almost stationary in position. The wind in all cases also blows in a direction nearly parallel with the isobars, having the region of lowest pressure on the left-hand. This has given rise to the simple law, propounded by Dr. Buys Ballot, for the Northern Hemisphere, viz.:—"Stand with your back to the wind, and the barometer will be lower

on your left hand than on your right." In cyclones the wind circulates in the opposite way to which the hands of a watch move, but exhibits usually a little in-draft; while in anticyclones the wind circulates in the same way as the hands of a watch, but exhibits usually a little outward motion. The intensity of the wind in all cases depends upon the closeness of the isobars; for the closer the isobars, the greater is the difference in pressure in a given distance, and consequently the stronger the wind.

Nearly all our weather is of the cyclonic or anticyclonic type, and is entirely dependent upon the form and distribution of the isobars. It is, therefore, by the aid of isobaric charts that we shall attempt to explain popular prognostics,[1] and to associate them with certain kinds of weather. The method of research actually adopted, has been for many years past to take notes of any good observation of any prognostic and put them in a portfolio, with the nearest synoptic chart available; or preferably with the nearest both before and after. When a sufficient number had been collected, they were analysed, and the remarkable result has been arrived at—that the greater number of prognostics are simply descriptive of the weather and appearance of the sky, in the different portions of the various shapes of isobars seen on synoptic charts; and that they indicate foul or fair weather just as they precede the shifting areas of rain or blue sky which are mapped out by the isobaric lines.

These charts not only show the success of the prognostics, but also explain wherein they sometimes fail, by tracing the changes of each particular condition of weather. Hitherto the only prognostics which have been accounted for have been those due to excessive damp, but by means of isobaric charts many others can be readily explained. It must not be supposed that the modern methods diminish the value of prognostics, for even in forecasting weather from synoptic charts they are of great value, and are always exceedingly useful to solitary observers who have only a single barometer to depend upon besides these prognostics, as for instance, on board ship.

We hope that the present paper will create an interest on the part of many in this subject, and show that it is within their power to assist in advancing the science of meteorology, so that it may not remain any longer in the unsatisfactory state set forth in the following old Bedfordshire lines:—

"'Well, Duncombe, how will be the weather?'
'Sir,—It looks cloudy altogether,
And coming across our Houghton Green,
I stopped and talked with old Frank Beane.
While we stood there, Sir, old Jan Swain
Went by, and said he knowed 'twould rain;

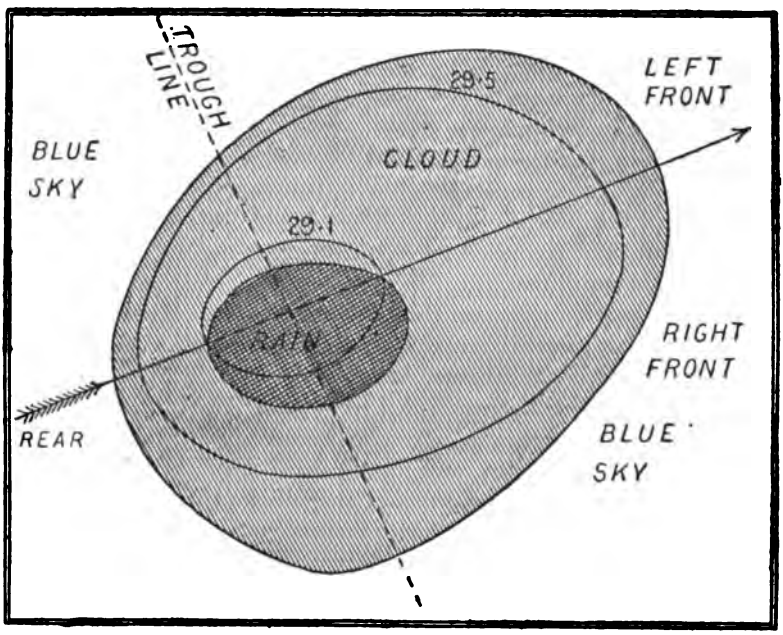
[1] The prognostics quoted in the paper have been mostly taken from the following works:—"*Popular Weather Prognostics of Scotland.*" By Arthur Mitchell, M.D.: *Edinburgh New Philosophical Journal*, October 1868.—"*Weather Lore.*" By Richard Inwards, F.M.S.: London, 1869.—"*A Handbook of Weather Folk Lore.*" By the Rev. C. Swainson, M.A.: Edinburgh, 1873.

The next that came was Master Hunt,
And he declared he knew it would'nt;
And then I met with Farmer Blow,
He plainly said he didn't know.
So, Sir, when doctors disagree,
Who's to decide it, you or me?'"

Cyclone Prognostics.

We shall first take a typical well-formed cyclone. In the accompanying diagram (Fig. 1), the broad features of the relation of cloud and rain to a cyclone centre are shown, the full line indicating the path of the depression, and the dotted line at right angles to it is the trough or *locus* of the lowest

Fig. 1.



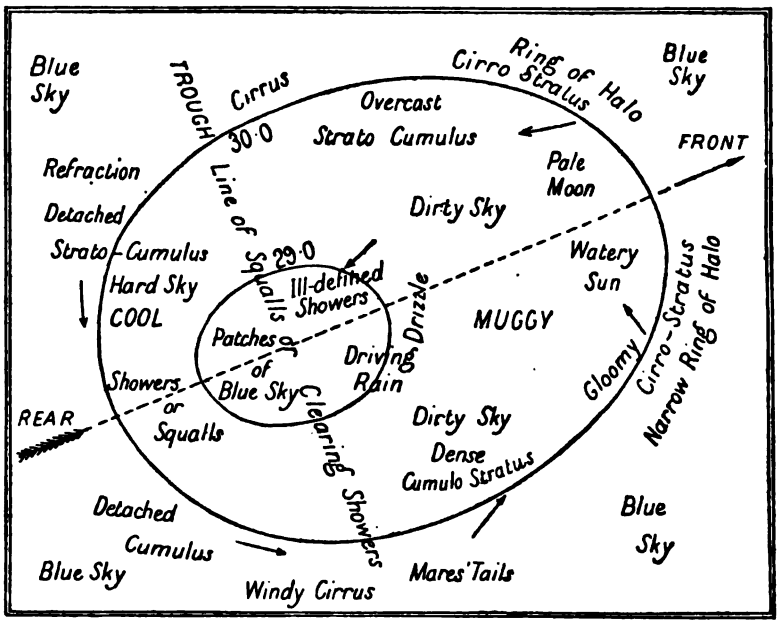
Weather in a Cyclone, November 14th, 1875.

reading of the barometer. In the extreme front of the depression there is a blue sky, then, as the barometer begins to fall, and sometimes even before that takes place, a bank of cirro-stratus, preceded by a halo-bearing sky, makes its appearance, which gradually becomes lower and denser, and forms an overcast dirty sky. In the whole front of the depression the temperature rises, and the atmosphere feels muggy and close. In the right-hand front the clouds assume the cumulo-stratus type, with driving rain later on. In the left-hand front the air is cooler but still oppressive, with an Easterly wind and overcast sky, succeeded by drizzling rain or ill-defined showers. When the trough of the depression has passed the barometer begins to rise, the wind

changes and becomes squally with showers of rain ; the air grows cooler, and the clouds break and ultimately clear away.

Now, with regard to the prognostics, by reference to Fig. 2, where the

FIG. 2.



Cyclone Prognostics.

characteristic weather in the different portions of a depression are given in a diagrammatic form, it will be seen that the first indication of a coming change is the appearance of a halo round the sun or moon in the cirro-stratus cloud. Hence,

> "When round the moon there is a brugh,[1]
> The weather will be cold and rough."

"The moon with a circle brings water in her beak."

"Halos predict a storm (rain and wind or snow and wind) at no great distance, and the open side of the halo tells the quarter from which it may be expected."

"Mock suns predict a more or less certain change of weather."

With regard to the open side of the halo indicating the quarter from which the storm may be expected, it does not appear that this can be much used as a prognostic. It, however, most probably originated in the fact that halos are often seen in the South-west or West, when the sun or moon is rather low, the lower portion of the halo being cut off by clouds banking up in that direction ; and that our storms generally come from those quarters.

As a specimen of the value of prognostics, we give some details of halos. When rain does not fall within thirty-six hours, any subsequent rain probably

[1] Halo.

belongs to a new-depression. During the six years ending June 1882, 155 solar halos and sixty-one lunar halos were observed in the neighbourhood of London, and they occurred with the following winds :—

	N.	NE.	E.	SE.	S.	SW.	W.	NW.	Total
Solar Halos	9	7	17	8	22	28	59	5	155
Lunar Halos.....	4	3	8	3	8	11	21	3	61
With Solar Halos									
Rain began to fall on the same day	3	1	10	4	15	12	36	0	81
,, ,, ,, 1st ,,	1	2	1	2	2	10	12	1	31
,, ,, ,, 2nd ,,	0	0	1	0	2	1	4	2	10
,, ,, ,, 3rd ,,	3	1	0	0	0	1	1	1	7
No Rain	2	3	5	2	3	4	6	1	26
With Lunar Halos									
Rain began to fall on the 1st day..	1	1	3	3	3	9	13	1	34
,, ,, ,, 2nd ,,	0	1	0	0	1	1	3	0	6
,, ,, ,, 3rd ,,	1	1	2	0	3	1	0	1	9
,, ,, ,, 4th ,,	0	0	0	0	0	0	3	1	4
No Rain.....	2	0	3	0	1	0	2	0	8

After the halo comes the pale or watery sun and moon :—

"When the sun appears of a light pale colour, or goes down into a bank of clouds, it indicates the approach or continuance of bad weather."

"If the sun goes pale to bed,
'Twill rain to-morrow, it is said."

"A red sun has water in his eye."

"When the moon has a white look, or when her outline is not very clear, rain or snow is looked for."

From the extreme damp in this part of the depression, while the sky generally is pretty clear, cloud forms round, and "caps," the tops of hills; a circumstance which has given rise to numerous local sayings :—

"When the clouds are upon the hills
They'll come down by the mills."
"When Cheviot ye see put on his cap,
Of rain ye'll have a wee bit drap."
"If Riving Pike[1] do wear a hood,
Be sure the day will ne'er be good."
"When Bredon Hill[2] puts on his hat,
Ye men of the vale beware of that."

From the same excessive damp the following may be explained :—

"When walls are more than usually damp rain is expected."

"Doors and windows are hard to shut in damp weather."

"The sailor notes the tightening of the cordage on his ship as a sign of coming rain."

"A lump of kelp acts as a good hygrometer, and prognosticates rain when it becomes damp."

"When walls, built of stones which have been quarried below high-water mark, become damp, wet weather is at hand."

[1] Rivington Pike is five miles north-west of Bolton.
[2] Midway between Evesham and Tewkesbury.

Also, owing to excessive moisture, clouds appear soft and louring, and reflect the glare of ironworks and the lights of large towns.

"The glare of the distant Ayrshire ironworks being seen at night from Cumbrae or Rothsay, rain is expected next day."

"In Kincardine of Monteith (Perthshire) and in all that district, the reflection from the clouds of the furnaces of the Devon and Carron works (to the east) foretells rain next day."

Also,

"When the flames of candles flare and snap, or burn with an unsteady or dim light, rain, and frequently wind also, are found to follow."

This is especially applicable to oil lamps or tallow candles.

As the depression approaches and the atmosphere becomes gloomy, close, and muggy, some people are troubled with rheumatic pains and neuralgia, old wounds and corns are painful, animals and birds are restless, and drains and ditches give out an offensive smell.

"When rheumatic people complain of more than ordinary pains in the joints, it will rain."

"If corns, wounds, and sores itch, or ache more than usual, rain is to fall shortly."

"A coming storm your shooting corns presage,
And aches will throb, your hollow tooth will rage."

"When animals seek sheltered places instead of spreading over their usual range, an unfavourable change is probable."

"Hark! I hear the asses bray,
We shall have some rain to-day."

"If oxen turn up their nostrils and sniff the air, or if they lick their fore feet, or lie on their right side, it will rain."

"Goats leave the high grounds and seek shelter before a storm."

"Hogs crying and running unquietly up and down with hay or litter in their mouths, foreshow a storm to be near at hand."

"When birds of long flight—rooks, swallows, or others—hang about home and fly up and down, or low, rain or wind may be expected. (This 'tumbling' of rooks is amongst the best known signs of rain in places where those birds are found.)"

"When the peacock loudly bawls
Soon we'll have both rain and squalls."

"If toads come out of their holes in great numbers, rain will fall soon."

"If glowworms shine much it will rain."

"When gnats bite keenly, and when flies keep near the ground, we look for wind and rain."

"When spiders' webs are seen floating about in the air, farmers regard it as a sign of coming rain."

"When many bees enter the hive and none leave it, rain is near."

Also from cloud and gloom plants shut up their petals early.

"The *Convolvulus arvensis* (small bind-weed), *Anagallis arvensis* (scarlet pimpernel) and *Calendula pluvialis*, shut up their flowers before approaching rain. (The pimpernel has been called the poor man's weather glass.)"

Dr. Jenner's well-known lines are very good, as they contain references to most of the natural prognostics. It will be seen, however, later on that the

sayings about the rainbow, distant hills and whirling dust, though good prognostics, do not belong to a depression:—

"The hollow winds begin to blow,
The clouds look black, the glass is low,
The soot falls down, the spaniels sleep,
And spiders from their cobwebs peep.
Last night the sun went pale to bed,
The moon in halos hid her head.
The boding shepherd heaves a sigh,
For, see! a rainbow spans the sky.
The walls are damp, the ditches smell,
Closed is the pink-eyed pimpernel.
Hark! how the chairs and tables crack,
Old Betty's joints are on the rack;
Her corns with shooting pains torment her
And to her bed untimely send her.
Loud quack the ducks, the peacocks cry,
The distant hills are looking nigh.
How restless are the snorting swine!
The busy flies disturb the kine.
Low o'er the grass the swallow wings,
The cricket, too, how sharp he sings!
Puss on the hearth, with velvet paws
Sits wiping o'er her whiskered jaws.
Through the clear stream the fishes rise
And nimbly catch th' incautious flies.
The glowworms, numerous and bright,
Illumed the dewy dell last night.
At dusk the squalid toad was seen
Hopping and crawling o'er the green.
The whirling dust the wind obeys,
And in the rapid eddy plays.
The frog has changed his yellow vest,
And in a russet coat is dressed.
Though June, the air is cold and still,
The mellow blackbird's voice is shrill.
My dog, so altered in his taste,
Quits mutton bones on grass to feast.
And, see yon rooks, how odd their flight,
They imitate the gliding kite,
And seem precipitate to fall,
As if they felt the piercing ball—
'Twill surely rain—I see with sorrow
Our jaunt must be put off to-morrow.

As the depression centre approaches still nearer, rain sets in and continues till the barometer turns to rise. The passage of the trough is often associated with a squall or heavy shower, commonly known as "a clearing shower." Immediately the air becomes cooler and loses the former muggy sensation, and soon small patches of blue sky appear.

"When as much blue is seen in the sky as will make a Dutchman's jacket (or a sailor's breeches), the weather may be expected to clear up."

"A small cloudless place in the north-east horizon is regarded both by seamen and landsmen as a certain precursor of fine weather or a clearing up."

The steady rain breaks up into showers or cold squalls, which are followed by hard detached cumulus or strato-cumulus, till the sky becomes blue again.

"When, after a shower, the cirro-strati open up at the zenith, leaving broken or ragged edges pointing upwards, and settle down gloomily and compactly on the horizon, wind will follow, and will last for some time."

This is descriptive of a clearing up before the windy portion of a depression has passed.

In the south of the depression near the outskirts windy cirrus and "mares' tails" are observed, which indicate wind rather than rain, as they are south of the rainy portion.

"The cloud called goat's hair, or the grey mares' tail, forebodes wind."

"If clouds look as if scratched by a hen,
Get ready to reef your topsails then."

"Mackerel sky and mares' tails,
Make lofty ships carry low sails."

The shift of the wind is different in the right-hand portion of the depression to what it is in the left-hand portion. In the former, on its first approach, the wind backs to South and falls very light – to an almost ominous calm. The first puffs or "paws" of wind give rise to a noise in tree-tops without much wind, and little eddies of dust, or to a whistling of the wind in-doors, which are all well-known signs of rain. Then as the depression passes along the wind gradually veers to South-west and West, with increasing strength. Hence

"When the wind veers against the sun,
Trust it not for back 'twill run."
"When the wind is in the South,
It is in the rain's mouth."

In the left-hand side of the depession the wind will back right round from South, through East, to North and North-west. In the rear of the depression on the left-hand side the wind blows from North-east and then North, when the clouds begin to break, and the weather to clear. When the depression has nearly passed away the wind in the rear draws round to North-west, and gradually abates, and the weather becomes fine. Hence the saying—

"Do business with men when the wind is in the North-west."

This, bringing the finest weather, is said to improve men's tempers, as opposed to the neuralgic and rheumatic sensations felt in front of a depression.

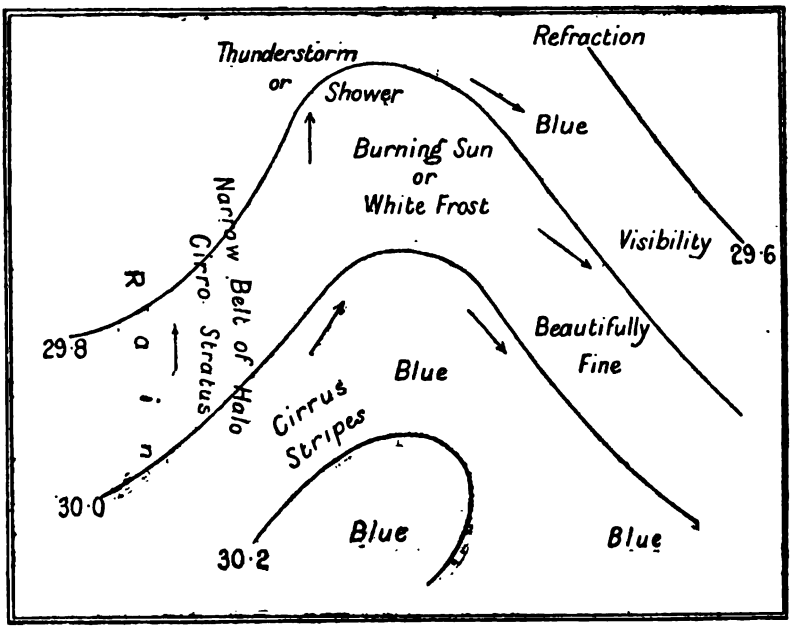
Wedge-shaped Isobar Prognostics.

Though the bulk of British weather is made up of cyclones and anti-cyclones, there are two other distributions of pressure, marked out by wedge-shaped isobars and straight isobars respectively, which have never before been described, but which are associated with many well-known sayings. The chief interest in these prognostics consists in the contrast which they

present to cyclone prognostics, as in many cases they are associated with fine or dry weather, as opposed to the damp of an approaching depression.

We shall first describe the prognostics which characterise the wedge-shaped area of high pressure that is frequently formed between a retreating and an advancing depression, as it is by far the most common. All these prognostics owe their value to the fact that as the new depression comes on rain may be expected. By reference to Fig. 8, it will be seen that in the rear of the

Fig. 8.



Wedge-Shaped Isobar Prognostics.

retreating depression the weather is beautifully fine, of the sort of which we should say that it was "too fine to last;" or, if it lasted a whole day, we should call it a "pet day."

"An unseasonably fine day in winter or spring is called a pet day in Scotland. The fate of pets, they say, awaits it, and they look for bad weather on the morrow."

During the day the sun is burning hot.

"When the sun burns more than usual, rain may be expected."

During the night white frost is formed, owing to calm radiation.

"A white frost never lasts more than three days; a long frost is a black frost."
"Frost suddenly following heavy rain, seldom lasts long."

As the day advances, after a white frost, the air becomes dull from the influence of the on-coming depression. Whence the saying—

"When the frost gets into the air, it will rain."

During the very fine weather on the east side of a wedge-shaped area, there is often great visibility with a cloudless sky.

"The further the sight, the nearer the rain."

"When the Isle of Wight is seen from Brighton, or Worthing, rain may be expected."

"When to the people about Arbroath the Bell-Rock light is particularly brilliant, rain is expected."

"About Cape Wrath, and along that part of the coast, when the Orkney Islands are distinctly seen, a storm or a continuation of bad weather is prognosticated."

"When from Ardersier and the adjoining parish, on the south-east side of the Moray Firth, the distant Ross-shire hills are distinctly seen in the morning, rain is expected that day."

"To the people in Eaglesham in Renfrewshire, when the Kilpatrick hills appear near, a change to wet is looked for; but when they appear remote, dry weather will continue."

"If the old moon embraces the new moon, stormy weather is foreboded. (Great confidence is placed in this old prognostic)."

"I saw the new moon late yestreen
Wi' the auld moon in her arm,
And if we gang to sea, master,
I fear we'll come to harm."

The reason of "visibility" is uncertain; the old idea that it was due to excess of vapour is certainly erroneous. The dry and wet bulb hygrometer always indicates a considerable amount of dryness when it is remarked; and Mr. Cruickshank has shown, by long observation at Aberdeen, that visibility is greatest at the driest season of the year.[1]

At the extreme north-west edge of a depression, there is often unusual "refraction," a well-known sign of rain. This seems to be due to the cold air in the rear of a depression being much below the temperature of the sea. If so, it is a sign of rain, for the reason that one depression is usually followed soon by another, which also explains the saying—

"A Nor-wester is not long in debt to a Sou-wester."

Refraction and visibility combined also explain the following curious local prognostic:—

"When Ailsa Craig is distinctly seen, and seems near at hand, the people of Cumbrae look for change. When the weather is going to be finer it lies flat; but when rain is coming it assumes the form of a mushroom."

Ailsa Craig is an isolated rock standing in the Firth of Clyde, about thirty miles from Cumbrae. It has a conical top, with precipitous sides, so that in ordinary weather only the top is seen lying flat on the horizon; but sometimes in the rear of a depression, it appears lifted by refraction, and the light encroaches at the edges, as is often seen with projecting promontories, giving the whole a fanciful resemblance to a mushroom. The prognostic is mistrusted by the inhabitants during frost, and we have proved it by our own observation.

[1] *Journal of the Scottish Meteorological Society*, Vol. V. p. 97.

On the West side of the wedge-shaped area, as the new depression comes on, the blue sky gradually assumes a dirty appearance, accompanied by a halo, and gathers into cloud, and later on rain begins to fall; while in the southern portion the rain is often preceded by strips of cirrus, either lying in the direction of the wind, or sometimes at right angles to it.

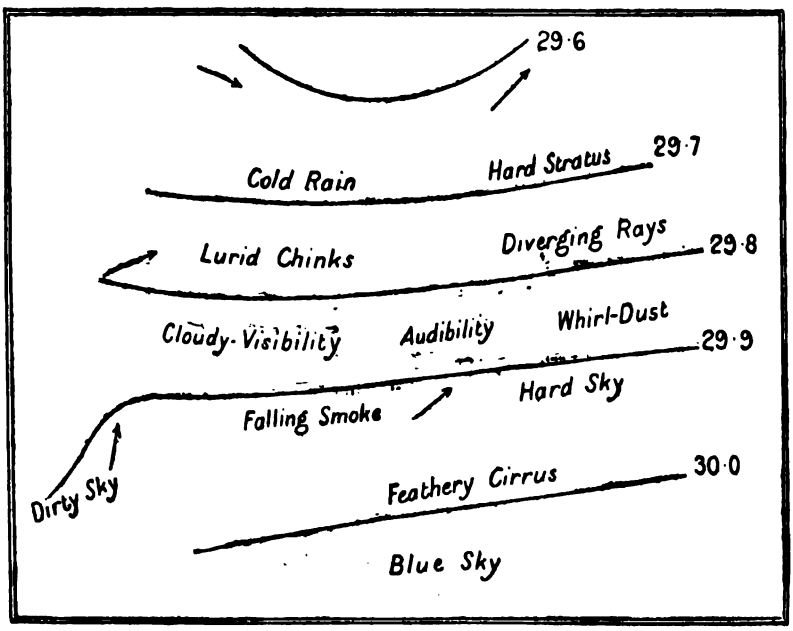
"Cirrus at right angles to the wind is a sign of rain."

Straight Isobar Prognostics.

Now we come to the consideration of some very interesting rain prognostics associated with straight isobars. While those in a depression are preceded by an almost ominous calm, and a dirty, murky sky; these are associated with a hard sky and blustery wind, of which it would be ordinarily remarked "that the wind keeps down the rain," or "that when the wind falls, it will rain." While also the prognostics which precede cyclone rain hold good for the reason that they are seen in front of the rainy portion, those associated with straight isobars hold good because, though there is little rain actually with them, the area which they cover to-day will probably be covered by a depression to-morrow—the conditions being favourable for the passage of depressions.

On turning to Fig. 4 it will be seen that while the pressure is high to the south, it is generally low to the north, without any definite cyclonic system, and that the isobars run straight nearly east and west. Near the high pressure the

Fig. 4.



Straight Isobar Prognostics.

sky is blue, then as we approach the low pressure feathery cirrus, or some form of windy sky, makes its appearance, while a blustery wind whirls the dust, or blows the soot down; and animals turn their tails to the wind to avoid its force on their faces.

"When chimneys smoke and soot falls, bad weather is at hand. The whistling of the wind heard within doors denotes rain."

"When sheep, cattle or horses turn their backs to the wind, it is a sign of rain."

Getting still nearer the low pressure, the sky is found to be gathering into hard stratus, at first with chinks between its masses, through which divergent rays stream down under the sun, which is spoken of as "the sun drawing water." Sometimes, especially in winter, these rays are lurid, and are referred to in the following prognostic:—

"Along the north shore of the Solway, from Dumfries to Gretna, a lurid appearance in the eastern or south-eastern horizon, called from its direction 'a Carlisle sky,' is thought a sure sign of coming rain. They describe it as lurid and yet yellowish, and the common saying is:—

"The Carle sky
Keeps not the head dry."

At the same time there is often great "visibility" with a hard overcast sky, and moderately dry air, in which the stratus seems to play the part of a sunshade, for as soon as the sun comes out the clearness of distant objects diminishes. This visibility must not be confounded with the visibility already described with a cloudless sky, which occurs with wedge-shaped isobars.

Simultaneously we often find "audibility."

"If the noise of a steamer or a railway train is heard at a great distance, bad weather is predicted."

This distinctness of distant sounds must be carefully distinguished from sounds which are not usually heard being brought up by the wind coming from a rainy quarter. For instance, the whistle of a railway-train to the south of a house will not be usually heard with the normal South-west wind of this country; but when the wind backs in front of a depression to the South, then it will be heard, and though this will be a good prognostic, still it is not true audibility.

"When the people of Monzie (Perthshire) hear the sound of the waterfalls of Shaggie, or the roar of the distant Turret clearly and loudly, a-storm is expected; but if the sound seems to recede from the ear till it is lost in the distance, and if the weather be thick, a change to fair may be looked for speedily."

"In Fortingall (Perthshire) if, in calm weather, the sound of the rapids on the Lyon is distinctly heard, and if the sound descends with the stream, rainy weather is at hand; but if the sound goes up the stream, and dies away in the distance, it is an omen of continued dry weather, or of a clearing up if previously thick."

The course of the Turret and Lyon is from west to east.

True "audibility" is best described by the saying—

"A good hearing day is a sign of wet;"

or,

"Much sound in the air is a sign of rain."

This last exactly conveys the kind of sound referred to. The reason why audibility is produced is unknown, but the old idea that it is due to excess of moisture in the air is certainly erroneous; in several instances we have observed that the upper current of the wind appeared to be moving much faster than the lower, and perhaps that may have something to do with it. When the gradients are very steep a little rain sometimes falls with straight isobars, generally in light showers, with a hard sky.

Though as a matter of convenience we have described the sequence of weather as we proceed from the high to the low pressure, it must be clearly understood that it does not represent the sequence of weather to a single observer, but rather what the weather will be simultaneously in different parts of the country; for instance, that if there is cirrus in London, there may perhaps be a lurid sky in Edinburgh. The prognostic value of all is due to the fact that a depression will soon form, which will probably extend over the whole country.

Anticyclone Prognostics.

Having spoken of cyclones we shall now direct attention to anticyclones. In the Daily Weather Charts we sometimes see but two or three isobars, and these are a considerable distance apart, and extend over a large area. The pressure is highest in the centre, and gradually diminishes outwards. The air is calm and cold in the central area, but on the outskirts the wind blows in the direction of the hands of a watch. These are the special features of an anticyclone. The weather in an anticyclone is almost the opposite of that in a depression; that in the latter being wet and unsettled; while that in the former is usually settled and fine with more or less haze in the air. Another great difference is that while depressions are generally rapid in their movements, anticyclones are nearly stationary; and it is for this reason that they are associated with "settled" fine weather. In the area of highest pressure these characteristic features are largely modified by what is termed "radiation weather" as determined by diurnal and seasonal variations; and as the pressure is nearly stationary, these diurnal and seasonal variations are the chief features of anticyclonic weather.

We shall now give the prognostics due to the variations in some detail (fig. 5, p. 40).

The sky being generally clear and the air calm, the temperature is high in the day and low at night. In summer brilliant sunshine prevails during the day; and at night there is heavy dew, and, in low-lying places, mist.

"Heavy dews in hot weather indicate a continuance of fair weather, and no dew after a hot day foretells rain."

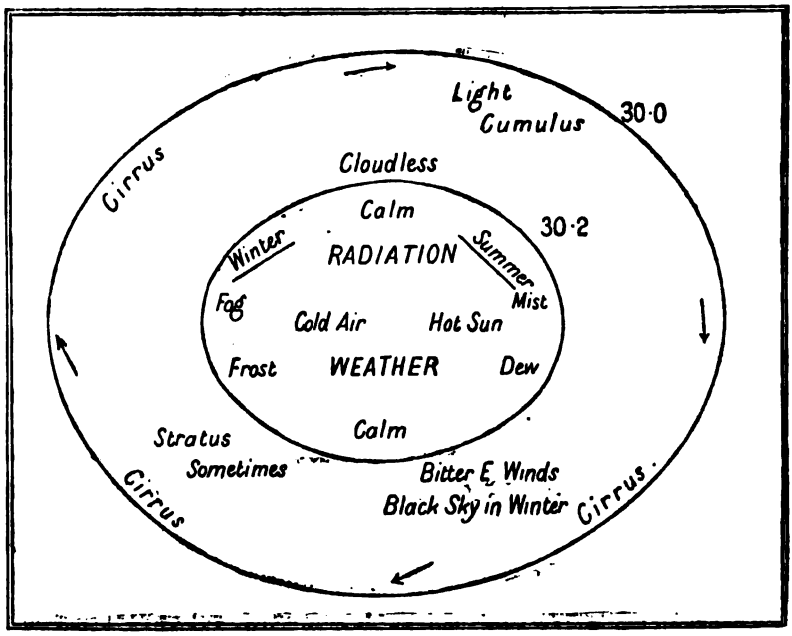
"If mists rise in low ground and soon vanish, expect fair weather."

"Thin, white, fleecy broken mist slowly ascending the sides of a mountain whose top is uncovered, predicts a fair day."

"When the mist creeps up the hill,
Fisher out and try your skill."

"When, in the morning, the dew is heavy and remains long on the grass, when the fog in the valleys is slowly dissipated and lingers on the hill-side, when the

FIG. 5.



Anticyclone Prognostics.

clouds seem to be taking a higher place, and when a few loose cirro-strati float gently along, serene weather may confidently be expected for the greater part of that day."

These all refer to night radiation, mist being dispersed by the sun's rays.

Fine, bright, genial weather raises the spirits and exerts an enlivening influence not only on human beings but also on animals, birds, insects, &c. Hence the saying—

"If larks fly high and sing long, expect fine weather."

"When sea-birds fly out early and far to seaward, moderate winds and fair weather may be expected."

"If rooks go far abroad, it will be fine."

"Cranes soaring aloft and quietly in the air, foreshow fair weather."

"If kites fly high, fine weather is at hand."

"Wild geese, wild geese, ganging out to sea,
Good weather it will be."

"When owls whoop much at night, expect fair weather."

"Bats, or flying mice, coming out of their holes quickly after sunset and sporting themselves in the open air, premonstrates fair and calm weather."

"Chickweed expands its leaves boldly and fully when fine weather is to follow."

In winter frost is generally prevalent in the central area of an anticyclone accompanied frequently by fog, which is most dense in the neighbourhood of large towns. This is all due to the radiation of calm weather.

"White mist in winter indicates frost."

"In the evenings of autumn and spring, vapour arising from a river is regarded as a sure indication of coming frost."

This comes from the air being colder than the water.

"When fires burn faster than usual, and with a blue flame, frosty weather may be expected."

This is caused by the reduced temperature of the outer air making a better draught in the chimney.

"In winter, when the sound of the breakers on the shore is unusually distinct, frost is indicated."

These last two prognostics are explained by the fact that the atmosphere is very dense and still in an anticyclone.

In those places where fog does not form, the sky will often be clear at night, whence

"Clear moon,
Frost soon."

"In winter when the moon's horns are sharp and well defined, frost is expected."

The wind in an anticyclonic system blows in the direction of motion of the hands of a watch but slightly outwards, and as the anticyclone is nearly always stationary the wind blows from the same quarter for several days together.

"When the wind turns from North-east to East and continues two days without rain, and does not turn South the third day, nor rain the third day, it is likely to continue North-east for eight or nine days, all fair, and then to come to the South again."

"If the wind is North-east three days without rain,
Eight days will pass before South wind again."

The wind is usually very light in force.

"It is said to be a sign of continued good weather when the wind so changes during the day as to follow the sun."

"If wind follow sun's course expect fair weather."

This "veering with the sun," as it is called, is the ordinary diurnal variation of the wind, which in this country is only very obvious with the shallow gradients of an anticyclone. At sea-side places in summer very often "the wind is in by day and out by night," which is the equivalent of the land and sea breezes of the Tropics. Like the two preceding prognostics, it is only in anticyclones that local currents of air, probably due to unequal heating of sea and land, can override the general circulation of the atmosphere in this country.

Sometimes in winter on the southern side of the anticyclone bitter East winds, with a black looking sky, will prevail for several days together, when it may truly be said :—

"When the wind is in the East
'Tis neither good for man nor beast."

Sometimes also the sky in this region will be covered with a uniform stratus cloud which is not of any great thickness, and when breaks occur, the sun is seen to be shining brightly above.

On the north-east side of the anticyclone in summer light cumulus clouds

frequently form in the morning, gradually increase till after the maximum temperature has passed, and then decrease and disappear towards evening.

"If woollen fleeces spread the heavenly way,
Be sure no rain disturbs the summer day."

"When the cumulus clouds are smaller at sunset than they were at noon, expect fair weather."

"Clouds small and round like a dapple grey with a North wind—fair weather for two or three days."

The cirrus cloud is usually seen on the outskirts of the anticyclone; if in the front, it gradually disappears, but if in the rear, it is a sign that there will be a change in the weather. Hence,

"If cirrus clouds dissolve and appear to vanish, it is an indication of fine weather.'

"If cirrus clouds form in fine weather with a falling barometer, it is almost sure to rain."

"When, after a clear frost, long streaks of cirrus are seen with their ends bending towards each other as they recede from the zenith, and when they point to the north-east, a thaw and a South-west wind may be expected."

Both these latter prognostics refer to a depression coming in and "breaking up the weather" and the anticyclone.

Conclusion.

We have endeavoured in this paper to deal with such prognostics as can be readily classified; but besides these, there are many more, what may be termed unclassified prognostics. Our object has been to show the relation between certain prognostics and certain forms of isobars, and by this means to assign them their proper value. It cannot be doubted that if careful attention were given to the observation of the aspect of the sky, the different forms of cloud, and local signs, these would prove, even in conjunction with a single barometer reading, of great assistance in predicting the weather. Of course, those persons who live in the neighbourhood of large towns labour under a great disadvantage, as the sky has nearly always a dirty appearance, and is frequently obscured by smoke. For this reason London is about the worst place to reside in for studying the weather.

We have only been able to give the rudiments of the new method of considering prognostics, for the method is capable of great extension; and we hope that we may succeed in interesting some of the Fellows sufficiently to induce them to observe prognostics in conjunction with the Daily Weather Charts.

In conclusion, we would venture to express our opinion that the observation of local signs of weather ought to form a most important element in all arrangements for telegraphic reporting for the purpose of forecasts, and that the duty should be impressed upon the observers of reporting at once important changes in the local and general signs of the weather. Great attention should also be paid to the observation of the forms and motion of clouds; and as considerable lack of knowledge prevails, even on the part of good observers, regarding the different forms and modifications of clouds, we are

glad to see that the Meteorological Office has already commenced systematic observations of cirrus clouds. Telegraphic observers should be specially instructed in cloud observations and prognostics by some one thoroughly well versed in the subject, so that there may be strict uniformity among all the observers; but we admit that the proposal presents serious difficulties in the way of realisation.

Theoretically, when the isobars are well-defined, we ought to be able to write down the prognostics which might be visible, but practically we cannot do so. Besides, there are sometimes cases of isobars which have no well-defined shape, but with which thunderstorms or heavy showers often occur. These, as is well known, do not affect the barometer, but are abundantly forewarned by the commonest prognostics, and as the rainfall is usually heavy in them, the failure of the forecast which omits to notice them is very conspicuous.

The scope of this paper precludes us from entering into the complicated question of the non-cyclonic rainfalls in this country. It will be enough to state that the prognostics which precede them are rather those associated with broken weather, such as bright sunrises or heavy clouds banking up without the barometer falling, than the muggy, dirty weather of a cyclone front. The warning they give is also much shorter, rarely more than three or four hours, if so long.

The results of this paper may be summarised as follows:—

The authors explain over one hundred prognostics by showing that they make their appearance in definite positions relative to the areas of high and low atmospheric pressure shown in synoptic charts. The method adopted not only explains many which have not hitherto been accounted for, but enables the failure, as well as the success, of any prognostic to be traced by following the history of the weather of the day on a synoptic chart. The forms discussed are:—cyclones, anticyclones, wedge-shaped and straight isobars. The details of weather in the last two are now described for the first time.

They also point out (1) that prognostics will never be superseded for use at sea, and other solitary situations; and (2) that prognostics can be usefully combined with charts in synoptic forecasting,—especially in certain classes of showers and thunderstorms which do not affect the reading of the barometer.

DISCUSSION.

Dr. TRIPE said that some of the Fellows might think the Paper hardly suitable for reading at a meeting or printing in the journal of a scientific society, but many of them took an interest in such papers because they were comparatively simple. In reference to the table of solar and lunar halos in connection with rainfall, it appeared that rain was pretty sure to fall within three days after the occurrence of a lunar halo, and to the extent of 80 per cent., as regards solar halos on

the first or second day[1]. He considered visibility was a good prognostic, and afforded a more certain indication of the speedy occurrence of rain than even mares' tails. What caused visibility was unknown to him. The prediction of rain from damp walls depended chiefly on the previous weather; a sudden change from cold to warm would have the effect of making walls condense the moisture contained in the air without approaching rain. The falling of soot down a chimney was, he thought, hardly a good prognostic; it was caused to a great extent by the direction and force of the wind, and also the angle at which the wind struck the chimney-pot. He considered the Paper a good one and a step in the right direction.

Dr. MARCET said, with regard to visibility being a sign of rain, he had himself observed on the borders of the Lake of Geneva that if the mountains on the opposite side of the lake could be seen very distinctly on a cloudy day, rain was likely to fall within a short period. On such occasions the coast appeared much nearer than usual. The late Professor de la Rive, of Geneva, ascribed this phenomenon to the atmospheric dust being hygrometric, and becoming transparent in damp weather from the moisture it absorbed.

Mr. STANLEY remarked that solar and lunar halos depended upon the moisture in the air, and that a sign of rain could be better assured by reference to the hygrometer. He thought that fine weather in front of a cyclone was due to increase of pressure, and therefore of temperature, caused by the onward march of the cyclone. This increase of temperature was known to render sound more audible, and by making the air clearer, distant objects became more visible. It was known that condensed vapours disappeared under a slight increase of pressure, just as, conversely, under the ordinary air-pump, vapours appeared on a diminution of pressure. He considered that the fall of rain in the centre of a cyclone was caused by the decrease of pressure due to the tangential action of the air in the cyclone. The straight isobars described in the Paper were, he thought, in segments of a very large cyclone, which was general in all large displacements of air.

Captain TOYNBEE thought that the great clearness of the air experienced when isobars took the wedge-shaped form, was due to the fact that such isobars represented a ridge of high barometrieal pressure which lay between two cyclonic systems, and that the high pressure of the ridge was maintained by air which had previously risen in front of the advancing cyclonic system, when it had lost most of its moisture, and now came down as a dry, pure, clear North-westerly wind. Hence the clearness of the air was, where wedge-shaped isobars were being experienced, a sign of rain, because it indicated the fact that a cyclonic system would soon advance over the same position. This explanation was based upon the Rev. W. Clement Ley's theory of the motion of air in cyclonic systems.

Mr. SCOTT thought that it might have been desirable to give the authorities or sources from which some of the principal sayings had been derived, in order to show which were general and which of more local import. Reference had also been made to the prevalence of bad smells with a falling barometer, and to the fact that rheumatic affections and neuralgia were felt especially at such a time; but no attempt had been made to explain the connection of these phenomena. It was a well-known fact that a sudden reduction of pressure, such as that experienced by divers when they returned to the surface of the water, produced neuralgic affections. The authors had described straight line isobars and their accompanying prognostics, but only for West winds, for pressure lowest in the North. He should be glad to see the list of prognostics extended, so as to include those for straight isobars with East winds when the pressure was lowest in the South. With regard to refraction being a prognostic of rain, in some cases it was a prognostic of Easterly winds, and was recognised as such in the

[1] The calculation on which his remark on halos was founded was as follows:—

Rain occurred in connection with	Solar Halos.			Lunar Halos.		
Direction of Wind	S.	SW.	W.	S.	SW.	W.
No. of observations.....	22	28	59	8	11	21
	o/o	o/o	o/o	o/o	o/o	o/o
Rain within forty-eight hours	79	78	81	50	91	76
,, on third day	9	3	7	40	9	0

West of Cornwall. In the past summer he had himself verified this latter statement on several occasions at Scilly and the Land's End. The authors, he thought, spoke a little too strongly when they said the barometer gave no sign of thunderstorms. The type of isobar which accompanied these was well known; it exhibited small undulations or incipient bights representing imperfectly formed secondary depressions. At the same time he must say that no one yet, in Europe at least, had been able to forecast correctly the amount of rain for a given day in a given place. The probability of some rain could be recognised, but no attempt could be made to estimate its amount. This was apparently owing to ignorance of the conditions of the upper atmosphere.

Mr. DYASON expressed an opinion that the formulators of weather prognostics in the past must have been colour blind, an affliction from which he was not sure that the authors of the paper were exempt. "Where are the scarlet, orange, green or gold harmonious, and the general glow?" He had endeavoured in a series of sketches of skies and clouds to portray the colours as they presented themselves to his mind. In relation to visibility, he referred to the Lakes of Geneva and Lucerne, quoting the lines used in the locality of Mont Pilate :—

"Si Pilate a un chapeau, le temps se mettra au beau,
A-t-il un collier, on peut la montée risquer,
Mais s'il porte son épeé, il y aura une ondée."

Mr. Dyason exhibited a sketch of the Matterhorn, taken south of Zermatt, during intense visibility. He did not admit "that London was a bad place for skies;" those he now exhibited were sketched in a North-western suburb of the metropolis.

Professor ARCHIBALD considered that some of the prognostics mentioned in the Paper required more explanation. For instance, it was stated that candles burned with an unsteady light in damp weather, but no reason was given why they should do so. One very good prognostic in use in Scotland appeared to have been omitted, namely :—"The North-west wind is a gentleman and goes to bed." He would also like to know why fires burned with a blue flame in frosty weather. He considered that visibility was often merely a local phenomenon connected with temperature. He had noticed intense visibility and a fog in juxtaposition on that very day, when travelling to London from Tunbridge Wells.

Mr. SYMONS pointed out that although it might be useful to trace the origin of some of the weather proverbs, it would be extremely difficult, and perhaps impossible, as some of them were very ancient. With regard to the connection between lunar halos and rainfall, he thought that it would be curious, considering the large number of wet days in this country, rain falling on an average every other day, if some of them did not happen to follow lunar halos. Respecting doors and windows sticking in damp weather, this was rather the result of existing damp than a forecast of more damp to come; for if existing damp foretold coming damp, it was not easy to see how dry weather could ever occur. With regard to visibility, he was glad the authors had referred to Mr. Cruickshank's observations at Aberdeen, extending over twenty-one years, and Mr. Symons thought that much might be learned from a thorough discussion of similar observations.

Mr. WILSON directed attention to Professor Tyndall's theory that audibility was due to the homogeneity of the atmosphere.

Mr. C. HARDING thought that the Paper would be useful to an isolated observer, whose forecast was dependent upon his own observations. It appeared to him that in classifying the prognostics, the authors of the Paper had rather begged the question,—given a certain occurrence which was admittedly a prognostic of bad weather, this seems to have been consequently classed as belonging to the front half of a cyclonic disturbance. He suggested that with each occurrence of the prognostic in question it would be better to note the existing conditions of atmospheric distribution, and finally to classify by actual observation. He stated that the form of isobars described by the authors as wedge shaped had been referred to many years ago in various publications by Captain Toynbee as a "ridge" of pressure. Some distinction should have been made between the weather of an anticyclone in summer and in winter, as it differed materially. Audibility had been referred to as a sign of bad weather; he might

say that it was notorious in ballooning that for a given distance sounds could be heard more distinctly than on the earth, and in a recent ascent he had noticed that the shrill voices of children were much more audible than the voices of grown persons.

Mr. ABERCROMBY, replying, said that Dr. Tripe's analysis of halos was interesting, but that if rain did not fall within twenty-four hours after a halo, any rain after that would not be due to the cyclone which produced the halo, but to a new one. Damp walls were certainly due to excess of vapour, not to rapid changes of temperature. Soot was doubtless sometimes blown down by wind, but when used as a prognostic it rather referred to soot falling out of doors, and was to be attributed to excessive damp. Halos were unquestionably due to the presence of a thin film of ice-formed cloud, and not merely to the amount of moisture in the air. This ice film was only formed in front of cyclones or thunderstorms, and for that reason was a sign of rain. With regard to visibility, alluded to by several speakers, he could not admit that it was due to increasing moisture, for the hygrometer showed that it was not so. He agreed with Captain Toynbee, so far as believing that there was a descending current of dry clear air with a North-west wind on the front side of a "wedge," but he doubted if that was the whole explanation. In the centre of anticyclones there was also a descending current of dry air, but no "visibility." The diagram of straight isobars was given for Westerly winds, as that type was by far the commonest. Like every other shape of isobars, the details varied with the type of weather in which they occurred. In an elementary Paper, it was considered inexpedient to go into so much detail. In the case mentioned by Mr. Scott, isobars trending East and West but sloping towards the South, the same broad features as given in the diagram would be reproduced, but with a harder sky and an East or North-east wind. The prognostics would, however, be much more likely to fail; for cyclones in the Northerly or Easterly types, to which such isobars would belong, did not follow with the same regularity as in the Westerly type. The refraction, which was a prognostic of East winds on the South-west edge of an anticyclone, was very different from the refraction on the North-west edge of a cyclone, which portended a fresh storm. The chief difference was the haziness of the horizon in the former case as compared with its visibility in the latter. The latter kind was hardly known on the South coast of England. He strongly suspected that the condition common to both kinds was a relatively cool air over a comparatively warm sea. The type of isobar which exhibited incipient "bights," or imperfect secondaries, was doubtless that most frequently associated with thunderstorms; but the kind of thunderstorm alluded to in the Paper as showing no trace on the isobars undoubtedly occurred. Any reference to cloud or sky colours was intentionally omitted in this Paper, as also to prognostics relating to diurnal wind. Candles burned badly before rain, probably owing to a stagnant damp air. Blue flame was due to the formation of carbonic oxide when a fire burned very red on a frosty night. Doors and windows sticking in damp weather indicated rain, because damp preceded the rain-area of a cyclone. The idea suggested by Mr. C. Harding, that because certain prognostics were known to be associated with bad weather, therefore they were classed as belonging to the front of a cyclone, was entirely erroneous, and exactly opposite to what had been done. The method Mr. Abercromby had adopted for the last twelve years had been, when he observed a good example of any prognostic, to make a note, and put it by with the nearest synoptic chart for the day, or often with both the preceding and succeeding charts. When a sufficient number had been collected, the charts were examined, and the necessary deductions drawn from them. Thus the charts were classified according to the prognostics associated with them. The results of all these researches had been embodied in the Paper, and the important fact deduced was that every portion of every shape of isobars had a characteristic weather and appearance. The general fact of a "wedge" being associated with fine weather had been noticed many years ago by Captain Toynbee, but the details of weather in different portions, and their relation to prognostics, had a considerable amount of novelty.

Mr. MARRIOTT said that it would be impossible to give the authorities or sources from which all the sayings in the Paper had been derived, but the foot-note on page 28 contained a list of the works from which the quotations had been made. The authors on the present occasion had only dealt with certain

classified prognostics ; and this would explain why many others had not been noticed. They hoped, however, to deal with these in a future Paper.

Report on the Phenological Observations for the Year 1882. By the Rev. Thomas Arthur Preston, M.A., F.M.S.

[Read December 20th, 1882.]

The Phenological Year opened with unusual cold, the month of October having been the coldest experienced for sixty-four years. There were severe frosts on the 17th and 31st, but the most remarkable feature was the violent gale on the 14th. This gale did enormous damage, thousands of trees being uprooted, and even Cauliflowers half torn out of the ground by the wind in some places. Elms especially were blown down, whilst Oaks and other more firmly-rooted trees had their branches twisted off; and the leaves of the Oak, Elm, and Lime are described as having been killed by the gale. Subsequent frosts hastened defoliation, and in most localities the trees were more than half stripped by the end of the month. Tender garden plants, Dahlias, &c., were destroyed on the 15th, if not earlier. With November came a great change, for the month was almost the mildest on record. The fall of leaf progressed rapidly, and by the middle of the month was nearly completed ; but wild flowers, which seem to have stood the severe frosts, were plentiful ; and spring flowers were beginning to make their appearance. Hazel was found in flower at Salisbury, while Strawberries were gathered in North Wilts, and of course the Barren-Strawberry and other early flowers were frequent. Primroses were abundant in some places, but not in others.

December, on the whole, was a mild month, with open weather, and from this time until the end of April, except for a short period at the end of January and beginning of February, the weather continued remarkably mild and warm. Vegetation was evidently put out of its proper course, and extraordinary reports have been sent in of abnormal appearances. Gooseberries were in flower in many places, especially in Devonshire, and even as far north as Geldeston, whilst at Addington young fruit was formed ; broad beans also flowered very generally, and wild strawberries ripened during December and January in Dorset, Somerset, and Devon. But perhaps the most remarkable circumstance, and one which conveys a better idea of the open season, was the number of wild flowers which survived the winter months. In the *Journal of Botany* for June is printed a list of no less than 130 plants which were seen in flower by different observers in January and February ; although in no one place were more than fifty-eight seen in January and sixty-three in February, yet the large total is especially worthy of note. This state of vegetation rendered the true dates of flowering extremely difficult to decide. In the comparative small area of Somerset and Devon the dates given for the Snowdrop are spread over no less than seven weeks, the Ivy-leaved Speedwell over more than ten weeks, the Dog's Mercury over six weeks, and so on. In the Herts district again, considering

its small area, the dates are, if possible, still more variable. This arises no doubt from the different ideas different observers take of the condition of a plant when it is to be considered in flower, and I would therefore suggest that the rule about sending specimens to the Referee be rigidly enforced. In many cases, where specimens have been sent, no objection could be raised against the records, though this has not been so always, and consequently implicit reliance cannot be placed on unverified records.

But to return to the Report: not only were wild flowers abundant in January, but some trees were very forward. At Killarney the Horse-Chestnut had several sprays in leaf in January; at Stratford, two miles north of Salisbury, the Peach was in full flower before the 11th; whilst, on the other hand, the Alder and Hazel were backward in several places from the catkins having been nipped by a frost on the 22nd; but, taking the reports generally, vegetation was earlier than in any previous year except 1877.

The cold period at the beginning of February rather checked vegetation; still it made progress, and at Marlborough every plant came into flower before its mean date, in many instances very much so.

March was again a fine month, and vegetation unusually forward, in fact "all plants whose mean dates of flowering are in March were in flower in February, whilst those for April were mostly out in March," the weather too was favourable for farm work. Buds of trees generally began to burst about the middle of the month, Horse-Chestnuts being tinted by the 31st. At Killarney some were in flower on the 18th, and Hawthorn hedges decidedly so; whilst Lilac, Lime, Birch, and Sycamore were all ready to burst into leaf. The only drawback, if such it can be called, to this magnificent state of vegetation was a slight deficiency of rain, but this was remedied by a somewhat larger quantity of rain in April; the only adverse remark in the observers' reports is that at Hatton the wheat looked rather yellow, otherwise the crops were good and the grass forward and plentiful. Trees were gradually coming into leaf; but fortunately the Horse-Chestnut and Oak were the only ones in fairly full leaf by the 29th, for on that day a severe gale passed over the South of England and ruined all advanced foliage. At Isleworth "the leaves of the Lime, Oak, and Horse-Chestnut were severely injured; other trees also suffered, but the foliage of the Lime was blackened and beaten to death up to about one-eighth of its extent, the leeward side remaining green: in many cases one-third of the leafage was destroyed." The Horse-Chestnuts lost their leaves on the side exposed to the gale and did not recover for the rest of the season. The injury to the fruit blossom was perhaps more serious; the crops of Apples, Pears, Plums, and other fruit were much damaged, and the loss thus sustained was very serious. Perhaps, however, this gale must not be charged with the whole destruction of the fruit crop, for the weather during May, which was otherwise favourable for vegetation, was detrimental from a spell of East winds during the middle of the month, which caused the young fruit to drop off. The Oak was in leaf long before the Ash.

A change now came, spoiling all the fine prospects which the previous

weather had held out. June was a wet, ungenial month, with a fall of rain in excess of the average. It was therefore bad for haymaking; but yet where plants were sufficiently protected they were wonderfully luxuriant. Grasses of all kinds were perhaps in as fine a condition as has ever been known, but of course the wet prevented them from being made into Hay; in fact, in many places the grass, though cut, was allowed to rot upon the ground, and it was no unusual sight to see the young verdure growing through the old Grass, which had been left where cut. As an instance of the unusual growth of plants, it may be mentioned that a Sowthistle at Bradford-on-Avon was 5 ft. 6 ins. high, 4½ ins. round the bottom of the stem, and had its lower leaves 16 ins. long.

The Corn, too, which like other grasses had flowered abundantly, was damaged by rain, which destroyed a good deal of the pollen, and thus, though the flower was plentiful, quite one-third was rendered fruitless from being unable to set its seed. The extreme forwardness of wild flowers, up to this time almost universal, now fell off, and towards the end of the month flowers began to be later than usual; from the beginning of July they were uniformly late. Haymaking commenced in the South-west of England about the 10th of June, or a little later. At Wincanton "the season seemed very unfavourable for the Ash, some trees not having come into leaf at all, and in many the foliage was very thin, and had never been seen in flower or fruit." Potato disease was observed there about the 17th of June.

For the rest of the Phenological Year the weather was cold and damp, and harvest operations were much delayed; a good deal of Hay was harvested well, though there could not be much proof in it, as it was overgrown. Wheat on the whole was a good crop, better than could at one time have been expected; Barley was inferior, but Oats were generally fair; Roots of all sorts were very good. At Wincanton "Grapes out of doors did not ripen, and the few Apples which survived the spring frosts were generally small and poor. Plums were largely attacked by a fungus, and rotted instead of ripening. Raspberries were watery and very poor in flavour." Taking all things into consideration, the most important feature of the Phenological Year was the mild winter. The effect of this upon vegetation was favourable, for had it not been for the gale in April, foliage would have been luxuriant, and therefore free from insect attacks; but, curiously enough, the contrary effect has been produced on insect life, for the rarity of insects, especially butterflies and moths, has been the general remark of entomologists. In the case of Bees the scarcity of honey has been extraordinary; the Bees were able to store up a fair amount in the early part of the year, but the ungenial summer prevented them from working, and they had to feed on what they had already stored; hence the amount of honey obtained for exhibition purposes was less than has ever been known before. The Bees, too, soon consumed their stores, and feeding throughout the summer was the rule, so that bee-keeping was anything but profitable.

In reference to the different Species of Plants selected for observation, the Stations have been divided into five groups:—

(1.) Devon and Somerset, and counties to the West.

(2.) Other districts South of the Thames.

(3.) The Hertfordshire group.

(4.) Those districts South of lat. 52° 50′ N.

(5.) Those districts North of lat. 52° 50′ N.

Snowdrop.—This seems to have come out very generally by the 17th of January, the dates given for Westward-Ho and Wells being evidently too late; at Isleworth, a cold district, colder apparently than Parbold in Lancashire, it was very late.

Hazel.—The dates given for this are again widely different, ranging over a space of no less than six weeks, the greatest range being again in the South-west part of the country.

Lesser Celandine.—The amplitude[1] of this species is no less than nine weeks, from the 2nd of January to the 5th of March; in the Herts district the range is nearly six weeks.

Coltsfoot.—Specimens of this plant were seen in flower near London as early as the 6th of January, but it was not observed at Strathfield Turgiss till the 12th of March, on which day it was first noticed at Hatton. At Ware it was not observed in flower before the 28th of February.

Great Sallow.—Considering how very variable the times of flowering of the early-flowering plants have been, this has been singularly uniform; it was found on the 4th of February at Totnes, but elsewhere it came into flower about the 24th of February, and in a fortnight was very generally in flower throughout England.

Marsh Marigold.—In the South-west of England this began to flower in January, but not till the 4th of April at Parbold; large as this range is, it is extraordinary that its amplitude in Devonshire alone should be as much as nine weeks.

Blackthorn.—This is a very variable plant at the best of times; omitting the extreme dates, it came into bloom during the first half of March, and was thus decidedly early.

Greater Stitchwort.—Very fine specimens were gathered in January, but it did not begin to flower properly till the beginning of March; its amplitude for the Herts district was five weeks.

Germander Speedwell.—This, like the Stitchwort, was in fine condition in January in Devonshire and at Killarney, but its amplitude in some of the districts was large, in the Herts district seven weeks. This is curious, as apparently it had not been mistaken for some of the other Speedwells, judging from the dates. Unfortunately no specimens have been sent to the Reporter.

Bush Vetch.—At Harpenden, where plants seem very late, this is stated

[1] By this term is meant the difference between the earliest and latest dates of "first flowering."

to have been in flower as early as March 12th, earlier than anywhere else in England, and yet at Sawbridgeworth, in the same district, it was not found till the 12th of May, an interval of nearly nine weeks; the latter date may not be impossible, for it was not found at Isleworth till the 14th of May, but the earliest date in that district was the 6th of April, more than three weeks after the Harpenden date. For all other places north of the Thames the amplitude was only eleven days.

Comfrey.—This being a water-plant, it is important to notice the time of flowering, and the value of specimens is especially noteworthy in this case. In district No. 1 the amplitude appears to be thirty-two days; however, upon examining the specimens sent, the two latest are evidently incorrect, and omitting these, the amplitude is only six days. In district No. 2 the amplitude appears to be fifty-five days; but here again the Isleworth specimen is evidently advanced, and omitting this, the amplitude is reduced to eighteen days; the Herts amplitude is only six days. It may be considered, therefore, that this species was singularly uniform in the time of flowering; other late dates might probably have been equally well accounted for, had specimens been available.

Milkwort.—Two or three species at least, or what are generally considered as such, have been mixed together, consequently the dates are not comparable.

Ragged Robin.—This again is a water-plant, and except in district 2 its amplitude is small, only eight days in the Herts district, and four days in district 4.

Milfoil.—This was late in most places, though its amplitude is generally small; it was very late in Devonshire.

Iris.—In district 1 the amplitude was over three weeks, and in district 2 it was also large; but it was very late at Isleworth, possibly from its being a conspicuous plant, gathered as soon as it came into flower, and thus escaped the notice of the observer; omitting this date, the amplitude is thirteen days; in the other districts the amplitude was very small.

Spotted Orchis.—It seems probable that the early Purple Orchis is sometimes mistaken for this species. The amplitude is far too great generally; in Herts alone it is fifty days!

Rose.—This shrub, generally very uniform in its time of flowering, was not so in the present year; its greatest amplitude was in district 1, where it was four weeks.

Mallow.—As a rule, plants come into flower at Salisbury first, then Marlborough, and then Isleworth. In the case of the Mallow, the broad-leaved Willow-Herb and black Knapweed, the reverse is the case this year; these three plants came out about the same time. At present no reason can be given for this peculiar exception to the rule. In some other instances of plants flowering later in the season Isleworth takes the lead, as if the locality had become decidedly warmer.

The notices of the later flowering plants are very various, and their amplitudes correspondingly great.

TABLE I.

No. and Name of Plant.	Makr.	Totnes.	Babbacombe.	Westward Ho.	Tiverton.	Cullompton.	Yeovil.	Wincanton.	Salisbury.	Wells.	Downside.	Marlborough.	Strathfield Turgiss.	Wellington College.	Isleworth.	Croydon.	Mareefield.	Watford.	Harpenden.	Hoddesdon.	Hertford.	Ware.	Sawbridge-worth.	Wickham.
1. ANEMONE NEMOROSA	..	59	..	77	63	..	63	76	52	62	62	53	72	..	72	59	..	71	70	53	55	69	72	..
2. RANUNCULUS FICARIA	2	2	35	33	11	27	13	9	9	30	..	4	..	..	47	..	..	12	(36)	22	19	45	51	11
3. *Ranunculus acris*	..	..	128	122	95	121	100	106	100	..	..	73	..	..	106	113	..	..	86	..	97	110	101	101
4. CALTHA PALUSTRIS	..	..	41	68	79	69	23	85	63	68	61	27	77	..	88	69	..	71	78	73	80	..	81	..
5. *Papaver Rhœas*	..	134	163	142	129	159	..	162	137	177	..	125	130	141	147	134	..	141	145	..	138	..	133	..
6. *Cardamine hirsuta*	..	..	34	34	2	(13)	..	4	68	16	55	(18)	..	..	72	..	..	..	63	..	61	..	..	..
7. *Cardamine pratensis*	97	70	110	70	76	84	82	86	72	97	94	73	84	..	93	91	..	89	86	..	92	89	88	87
8. *Draba verna*	..	..	41	45	(63)	(62)	..	..	5	52	..	20	79	..	18	(29)	..	..	53	..	37	..	..	..
9. *Viola odorata*	..	9	..	..	13	52	60	..	59	41	69	58	..	..	72	57	..	..	8	74	23	..	..	..
10. *Polygala vulgaris*	80	..	..	80	110	..	95	130	91	119	104	132	..	..	..	106	117	..	..	..	129	..	..	..
11. *Lychnis Flos-cuculi*	..	130	142	131	132	(159)	..	137	109	..	..	134	132	141	137	141	148	143	142	..	124	..	..	..
12. *Stellaria Holostea*	72	85	81	88	..	10	..	84	72	104	100	70	62	..	69	64	..	67	72	91	67	63	98	71
13. MALVA SYLVESTRIS	..	133	163	146	150	(199)	..	154	152	152	..	162	175	166	148	150	154	153	127	..	150	..	151	..
14. *Hypericum tetrapterum* ..	..	..	..	196	181	199	..	201	190	196	..	(183)	..	..	200	..	..	..	..	..	182	..	..	174
15. *Hypericum pulchrum*	..	..	170	157	167	180	..	180	170	188	..	187	..	183	..	182	..	183	185	..	182	..	..	176
16. GERANIUM ROBERTIANUM	39	16	..	78	58	(10)	87	98	95	78	..	107	78	..	126	113	..	97	113	..	109	110	99	101
17. TRIFOLIUM REPENS	..	111	146	136	132	159	112	147	125	146	..	133	..	..	127	130	..	127	117	..	128	..	133	..
18. *Lotus corniculatus*	113	135	134	103	132	..	109	132	127	122	..	131	..	..	..	120	..	147	147	..	122	..	136	..
19. *Vicia Cracca*	..	158	..	159	163	185	..	170	163	171	..	182	..	167	201	(166)	..	168	185	..	158	..	..	..
20. *Vicia sepium*	113	78	100	98	73	116	89	98	96	114	106	104	..	146	134	106	..	100	71	..	101	120	132	99
21. *Lathyrus pratensis*	..	140	169	148	160	136	..	156	152	151	..	150	130	162	171	(154)	169	155	156	..	144	..	..	..
22. PRUNUS SPINOSA	51	69	72	67	63	87	75	79	34	(79)	100	68	73	..	76	64	..	81	74	50	69	75	78	..
23. *Spiræa Ulmaria*	..	166	(175)	150	170	166	..	154	151	159	..	159	166	162	..	168	..	155	156	..	148	..	..	..
24. *Potentilla anserina*	..	121	151	120	128	178	105	124	108	142	117	126	135	..	132	130	..	136	136	..	122	120	137	..
25. *Potentilla Fragariastrum*	..	..	35	..	(2)	13	..	..	(9)	..	..	..	..	..	66	..	..	22	23	..	5	69	70	..
26. *Rosa canina*	..	147	153	148	137	166	..	155	147	146	..	148	136	148	158	149	..	153	138	..	140	..	..	..
27. *Epilobium hirsutum*	..	..	..	181	201	194	..	186	186	194	..	207	..	..	188	191	191	188	190	..	187	..	..	..
28. *Epilobium montanum*	..	158	..	150	157	178	..	172	159	160	..	161	..	165	155	168	164	168	159	..	152	..	..	..
29. *Angelica sylvestris*	..	..	..	..	..	213	68	207	94	..	..	204	..	..	207	213	..	..	..	..	205	..	..	..
30. *Anthriscus sylvestris*	..	..	..	60	79	125	..	89	62	72	..	67	..	..	..	(7)	..	87	53	..	77	78	75	..
31. HEDERA HELIX	(249)	(291)	272	270	285	299	..	265	240	..	..	280	..	..	..	252	251	266	..	..	..	..	..	..
32. *Galium Aparine*	..	126	146	103	125	126	109	141	111	140	..	117	141	..	131	127	..	134	127	..	129	..	137	..
33. *Galium verum*	..	158	179	173	164	..	..	197	177	185	..	188	..	..	(200)	190	..	..	181	..	161	..	..	..
34. *Dipsacus sylvestris*	..	193	..	201	..	..	..	208	211	..	..	213	..	..	202	202	..	..	..	..	205	..	..	..
35. *Scabiosa succisa*	..	..	238	201	222	186	..	166	175	..	..	(220)	..	..	..	..	..	..	187	..	..	..	..	..
36. *Petasites vulgaris*	..	..	..	..	58	..	51	79	63	54	..	17	59	..	(101)	..	..	58	..	..	66	..	..	..

TABLE I.—*Continued.*

No. and Name of Plant.	Braintree.	Booking.	Geldeston.	Tacolneston.	Cambridge.	Cardington.	Addington.	Bradenham.	Oxford.	Banbury.	Cirencester.	Tidenham.	English Bicknor.	Malvern.	Belton.	Hatton.	Great Cotes.	Chester.	Kearsley Moor.	Parbold.	St. Michael's-on-Wyre.	Killarney.	Pomeroy.
1. ANEMONE NEMOROSA	(72)	82	..	..	(72)	56	77	..	55	(100)	65	67	60	53	64	80	69	..	(94)	75	66	(57)	68
2. RANUNCULUS FICARIA	17	57	24	..	28	35	(39)	28	22	42	..	33	11	35	19	64	44	41	74	45	31	(18)	51
3. *Ranunculus acris*	..	106	124	..	112	80	128	88	86	..	..	110	..	97	128	130	114	..	126	..	122	123	..
4. CALTHA PALUSTRIS	(76)	75	71	..	76	69	66	..	49	77	70	..	..	70	66	76	53	..	(109)	94	84	41	86
5. *Papaver Rhœas*	121	174	125	..	134	..	149	155	..	..	..	..	..	151	..	..	154	..	..	..	..	152	..
6. *Cardamine hirsuta*	..	..	75	..	67	..	..	..	51	(74)	..	..	..	(12)	..	..	..	..	..	..	..	(23)	..
7. *Cardamine pratensis*	88	93	84	..	79	93	96	.	82	94	80	75	..	75	95	107	73	..	(109)	94	79	101	103
8. *Draba verna*	..	..	57	..	32	8	59	..	..	(15)	32	..	..	(72)	43	(74)	..	..	..	..	..	..	..
9. *Viola odorata*	..	62	..	..	32	51	(55)	19	53	..	..	52	12	63	59	71	4	..	..	..	..	..	..
10. *Polygala vulgaris*	(146)	..	..	..	108	..	..	135	..	..	..	110	..	137	(110)	142	..	..	..	139	..	94	..
11. *Lynchnis Flos-cuculi*	(144)	..	137	..	137	..	140	..	..	140	..	..	..	136	..	154	148	..	152	..	..	141	..
12. *Stellaria Holostea*	(70)	68	81	..	..	98	105	75	77	97	..	..	63	68	87	110	89	..	(115)	..	86	74	..
13. MALVA SYLVESTRIS	(150)	180	147	167	160	..	166	155	..	154	..	..	176	..	..	155	172	..	..	..	168	161	..
14. *Hypericum tetrapterum*	(205)	..	194	..	194	..	..	..	..	..	181	..	..	..	..	..	..	..	..	..	..	..	..
15. *Hypericum pulchrum*	182	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	194	..	..	..	..	182	..
16. GERANIUM ROBERTIANUM	(110)	104	110	..	108	118	113	104	(89)	105	..	100	80	89	..	130	95	..	..	135	119	42	..
17. TRIFOLIUM REPENS	(150)	(146)	139	..	129	..	132	135	..	..	..	141	..	149	..	150	155	..	..	..	150	137	..
18. *Lotus corniculatus*	(138)	138	132	..	133	..	140	142	..	(149)	..	109	..	144	..	143	147	..	..	130	138	121	..
19. *Vicia Cracca*	..	165	183	..	189	..	..	..	..	..	..	..	176	..	..	168	173	..	..	..	163	152	..
20. *Vicia sepium*	..	104	115	..	..	..	..	104	86	(129)	..	109	..	..	..	..	..	..	143	..	112	68	..
21. *Lathyrus pratensis*	156	148	153	..	163	..	..	..	..	..	..	..	..	..	..	163	168	..	..	..	171	182	..
22. PRUNUS SPINOSA	(76)	80	77	..	74	69	(80)	(84)	71	(71)	71	80	(89)	72	72	87	77	..	..	..	94	41	70
23. *Spiræa Ulmaria*	..	162	163	165	170	171	164	..	..	..	179	..	175	..	..	168	..	..	..	..	163	192	..
24. *Potentilla anserina*	172	..	132	147	117	132	140	..	..	(149)	..	..	..	134	..	152	146	..	..	..	137	128	..
25. *Potentilla Fragariastrum*	(58)	61	18	..	..	..	..	11	..	..	..	43	(11)	16	..	..	..	8	133	45	10	18	18
26. *Rosa canina*	144	146	145	143	147	..	149	142	..	148	..	..	153	151	..	154	154	..	..	158	165	146	..
27. *Epilobium hirsutum*	190	185	190	..	191	..	..	..	..	..	(166)	..	(200)	..	..	..	202	..	..	185	192	179	..
28. *Epilobium montanum*	(182)	165	174	..	164	..	..	..	..	..	(176)	..	..	..	..	..	..	..	..	..	173	150	..
29. *Angelica sylvestris*	..	226	203	..	164	..	..	..	(64)	190	..	..	..	..	..	..	..	..	..	..	..	154	..
30. *Anthriscus sylvestris*	..	102	78	..	73	93	107	..	..	(138)	73	109	..	86	59	..	116	..	115	..	86	..	..
31. HEDERA HELIX	280	241	254	..	242	244	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	245	..
32. *Galium Aparine*	..	133	125	..	117	122	140	..	..	(148)	..	..	..	129	123	..	147	..	..	..	170	..	..
33. *Galium verum*	189	..	183	..	185	182	182	..	..	182	178	..	197	..	..	..	..	..	..	..	..	(161)	..
34. *Dipsacus sylvestris*	213	225	210	..	212	..	..	..	..	..	..	..	..	..	..	..	210	..	..	..	..	..	..
35. *Scabiosa succisa*	..	..	..	..	226	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	174	..
36. *Petasites vulgaris*	..	..	..	..	..	..	..	..	83	63	77	..	..	..	62	..	67	..	..	..	67	..	..

TABLE I.—*Continued.*

No. and Name of Plant.	Maker.	Totnes.	Babbacombe.	Westward Ho.	Tiverton.	Cullompton.	Yeovil.	Wincanton.	Salisbury.	Wells.	Downside.	Marlborough.	Strathfield Turgiss.	Wellington College.	Isleworth.	Croydon.	Maresfield.	Watford.	Harpenden.	Hoddesdon.	Hertford.	Ware.	Sawbridge-worth.	Wickham.
37. TUSSILAGO FARFARA	..	23	66	50	51	67	51	36	48	62	61	38	71	..	50	42	..	59	(48)	..	37	59	..	..
38. ACHILLEA MILLEFOLIUM.....	175	146	..	150	160	175	..	174	153	181	..	152	129	..	182	176	169	165	165	..	154	..	..	..
39. *Chrysanthemum Leucanth*.....	..	132	137	136	129	..	98	127	110	139	..	131	121	141	132	130	..	127	125	..	107	..	142	..
40. *Artemisia vulgaris*	..	..	..	..	129	(213)	..	..	198	..	..	(213)	..	..	220	204	..	218	..	..	..	..	..	..
41. *Senecio Jacobœa*	..	143	..	173	191	181	100	89	172	164	..	191	..	166	..	190	191	..	191	..	176	..	..	..
42. CENTAUREA NIGRA	..	171	..	157	136	178	..	181	148	151	..	186	..	162	159	152	149	168	178	..	150	..	..	..
43. *Carduus lanceolatus*	..	191	..	166	191	199	..	182	171	186	..	196	..	..	183	193	..	162	..	..	171	..	..	..
44. *Carduus arvensis*..	..	163	175	169	203	185	..	178	167	185	..	201	..	..	183	183	193	175	199	..	171	..	..	181
45. *Sonchus arvensis*.....	..	..	..	179	206	..	..	200	217	197	..	211	..	..	190	203	..	196	205	..	187	..	..	175
46. *Hieracium Pilosella*	..	126	139	136	128	..	98	133	111	118	..	129	..	138	126	127	117	120	119	..	112	..	..	..
47. CAMPANULA ROTUNDIFOLIA....	..	..	..	..	..	(185)	..	..	179	..	..	196	..	..	206	193	..	188	187	..	185	..	..	..
48. *Gentiana compestris*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
49. CONVOLVULUS SEPIUM.....	..	165	226	179	203	203	..	196	172	174	..	189	..	..	161	194	186	196	211	..	191	..	..	..
50. *Symphytum officinale*.....	..	(132)	..	99	129	..	100	105	94	..	..	103	..	..	149	112	..	109	..	111	106	112	109	..
51. *Pedicularis sylvatica*	..	..	..	..	97	..	86	117	90	111	104	107	125	..	..	113	115	..	..	..	122	..	..	..
52. *Veronica Chamædrys*	85	13	100	73	(39)	..	72	71	73	(38)	..	89	..	..	99	92	..	71	72	111	97	120	99	86
53. *Veronica hederifolia*	22	..	..	..	19	(59)	..	35	12	97	..	..	..	..	53	..	..	15	53	..	37	..	..	..
54. *Mentha aquatica*	..	..	219	..	215	213	..	206	213	..	..	..	..	..	211	204	..	211	..	..	..	..	..	..
55. *Thymus Serpyllum*	..	152	163	157	..	..	..	200	147	160	..	157	..	..	..	149	..	..	200	..	152	..	..	..
56. *Prunella vulgaris*	..	163	175	158	136	181	..	171	166	148	..	179	167	..	184	148	167	168	181	..	171	..	..	..
57. *Nepeta Glechoma*.....	56	54	80	52	69	69	69	68	62	59	87	68	71	..	76	78	..	78	78	..	72	78	77	..
58. *Galeopsis Tetrahit*	..	..	..	191	202	(248)	..	203	194	..	..	191	..	..	(199)	189	..	..	212	..	183	..	..	..
59. *Stachys sylvatica*	..	..	..	148	148	..	..	154	150	150	..	154	..	162	174	147	155	153	151	..	151	..	..	..
60. *Ajuga reptans*	..	96	113	91	110	(115)	90	98	101	101	..	101	121	..	120	106	..	106	108	..	110	..	117	98
61. PRIMULA VERIS	..	..	81	..	106	..	61	72	67	71	..	75	73	..	105	70	..	71	(17)	74	72	69	74	86
62. *Plantago lanceolata*	..	90	110	68	86	125	86	84	89	93	..	89	98	..	106	105	..	91	99	..	93	101	100	94
63. *Mercurialis perennis*	..	..	55	36	9	13	..	35	12	30	68	4	42	..	63	..	..	23	14	..	35	15	25	..
64. *Ulmus montana*	..	..	55	..	..	..	53	53	49	60	..	55	..	..	(72)	50	..	..	53	..	65	..	..	..
65. *Salix caprea*	..	35	58	60	55	(68)	59	65	54	60	73	61	(65)	..	69	57	..	60	62	62	68	75	69	..
66. *Corylus Avellana*	26	..	24	33	9	13	18	31	9	28	45	17	25	..	20	..	..	23	30	13	5	13	..	..
67. *Orchis maculata*	..	142	179	154	137	159	..	139	143	146	..	150	..	..	..	133	..	..	100	..	152	..	..	..
68. *Iris Pseud-acorus*	..	122	142	129	136	142	..	153	137	..	..	147	134	144	159	134	152	150	150	..	158	..	..	..
69. *Narcissus Pseudo-narcissus*....	..	35	..	49	51	51	59	60	54	63	..	52	47	..	(69)	..	..	..	64	62	57	(59)	(45)	..
70. *Galanthus nivalis*	7	10	..	(54)	17	9	16	11	7	(34)	..	17	21	..	27	..	..	13	15	(7)	2	19	(9)	..
71. *Scilla nutans*	..	78	97	75	87	99	80	81	73	74	87	80	83	..	90	89	..	89	87	91	79	84	..	87

TABLE I.—*Continued.*

No. and Name of Plant.	Braintree.	Bocking.	Geldeston.	Tacolneston.	Cambridge.	Cardington.	Addington.	Bradenham.	Oxford.	Banbury.	Cirencester.	Tidenham.	English Bicknor.	Malvern.	Belton.	Hatton.	Great Cotes.	Chester.	Kearsley Moor.	Parbold.	St. Michael's-on-Wyre.	Killarney.	Pomeroy.
37. TUSSILAGO FARFARA	..	61	84	..	48	..	(62)	..	32	(48)	..	62	..	63	43	71	43	28	42	45	41	55	45
38. ACHILLEA MILLEFOLIUM	..	181	174	..	168	182	182	..	..	171	..	..	176	..	..	..	201	..	..	..	171	155	..
39. *Chrysanthemum Leucanth.*	124	..	140	147	115	121	128	131	..	131	..	141	..	(130)	..	151	148	..	..	178	138	139	..
40. *Artemisia vulgaris*	..	..	208	220	210	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	226	..	..
41. *Senecio Jacobæa*	182	..	157	..	161	183	..	..	..	190	..	..	..	..	..	..	204	..	..	..	191	182	..
42. CENTAUREA NIGRA	(158)	159	174	..	164	..	..	..	..	154	166	..	175	..	..	..	187	..	..	207	205	156	..
43. *Carduus lanceolatus*	184	194	202	..	163	185	..	..	..	..	..	..	..	..	..	..	200	..	..	..	..	..	..
44. *Carduus arvensis*	(154)	193	179	..	191	182	..	159	..	..	..	..	..	..	..	..	191	..	..	..	..	..	..
45. *Sonchus arvensis*	..	229	200	209	192	185	..	..	..	..	171	..	..	..	..	..	179	..	..	..	217	..	..
46. *Hieracium Pilosella*	..	156	132	162	123	..	140	..	..	(149)	..	..	..	132	130	143	..	..	..	..	170	127	..
47. CAMPANULA ROTUNDIFOLIA	199	217	199	210	194	..	..	..	..	..	..	..	210	..	..	..	193	..	..	184	191	..	..
48. *Gentiana campestris*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	182	..
49. CONVOLVULUS SEPIUM	(193)	182	190	194	191	196	..	..	..	..	..	..	..	..	..	..	202	..	..	199	210	196	..
50. *Symphytum officinale*	152	123	..	..	85	..	..	..	..	..	..	..	..	126	..	..	..	..	..	..	..	130	..
51. *Pedicularis sylvatica*	..	..	..	..	..	..	..	..	78	..	..	95	..	..	..	127	..	..	..	..	..	109	..
52. *Veronica Chamædrys*	..	102	96	..	..	98	104	98	77	(97)	156	106	(102)	88	110	127	95	..	..	130	122	101	..
53. *Veronica hederifolia*	..	..	50	..	(32)	30	..	..	..	(7)	..	..	..	50	..	..	..	41	..	..	..	(19)	..
54. *Mentha aquatica*	218	218	203	209	214	222	..	..	..	..	..	..	..	..	..	..	..	..	..	..	222	227	..
55. *Thymus Serpyllum*	..	..	..	..	136	..	..	..	..	..	..	..	187	150	..	..	..	..	..	..	..	..	..
56. *Prunella vulgaris*	..	168	174	..	159	..	158	151	..	..	..	..	165	..	..	..	..	..	..	..	163	171	..
57. *Nepeta Glechoma*	(76)	..	77	..	74	77	76	(84)	64	78	..	..	..	68	88	78	93	..	..	110	95	(19)	..
58. *Galeopsis Tetrahit*	..	..	191	..	194	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
59. *Stachys sylvatica*	..	154	..	..	153	..	..	155	..	..	161	..	165	..	..	163	..	..	171	..	..	..	..
60. *Ajuga reptans*	(109)	104	108	..	(99)	116	98	125	..	(111)	..	114	116	114	121	..	..	..	133	125	130	105	..
61. PRIMULA VERIS	72	68	86	..	..	78	70	(88)	72	97	..	..	83	63	87	102	71	..	..	118	103	85	..
62. *Plantago lanceolata*	..	104	105	..	108	101	110	99	88	(100)	..	..	..	111	102	127	118	..	130	(125)	104	63	..
63. *Mercurialis perennis*	..	45	..	..	39	..	..	22	..	(43)	..	39	..	(10)	51	..	..	..	11	89	56	..	..
64. *Ulmus montana*	..	53	..	..	71	45	..	..	48	(62)	68	..	..	..	..	(69)	..	..	..	..	..	(49)	..
65. *Salix Caprea*	..	65	73	..	63	67	..	..	55	67	..	..	..	63	60	78	66	59	(68)	70	..	..	..
66. *Corylus Avellana*	..	20	20	..	48	30	(28)	35	24	(21)	35	41	..	12	30	..	..	35	..	42	..	20	..
67. *Orchis maculata*	144	..	..	..	..	..	121	..	..	..	..	..	..	..	..	154	155	..	..	175	(167)	..	..
68. *Iris Pseud-acorus*	151	149	..	152	154	..	155	..	..	..	..	..	..	..	..	152	..	..	..	154	160	123	..
69. *Narcissus Pseudo-narcissus*	..	..	..	.	(77)	60	60	..	81	50	..	61	62	53	..	..	58	..	70	69	64	34	46
70. *Galanthus nivalis*	..	20	2	..	..	5	(3)	..	26	(22)	..	..	16	(16)	6	..	..	16	..	..	16	15	..
71. *Scilla nutans*	93	..	92	..	84	..	(113)	91	80	(98)	..	..	89	90	92	100	108	..	109	103	107	74	..

TABLE II.

Average date of the Flowering of Plants for each year from 1875 to 1882.

No. and Name of Plant.	1875.	1876.	1877.	1878.	1879.	1880.	1881.	1882.
70. *Galanthus nivalis*	14	31	18	28	41	46	36	16
66. *Corylus Avellana*	13	24	12	34	39	57	41	20
2. RANUNCULUS FICARIA	61	57	36	35	73	64	66	29
63. *Mercurialis perennis*	47	69	32	50	80	65	62	25
37. TUSSILAGO FARFARA	72	62	51	53	66	61	70	53
25. *Potentilla Fragariastrum* ..	46	60	53	50	82	69	79	27
9. *Viola odorata*.....	48	50	46	56	70	64	72	35
65. *Salix caprea*	75	70	58	64	81	76	79	63
69. *Narcissus Pseudo-narcissus* ..	81	61	54	54	84	78	79	57
64. *Ulmus montana*	69	64	53	65	80	72	79	55
8. *Draba verna*	64	60	38	45	77	71	71	37
1. ANEMONE NEMOROSA	87	81	78	66	88	75	85	65
4. CALTHA PALUSTRIS	95	74	63	62	84	84	92	61
57. *Nepeta Glechoma*	100	92	91	74	101	86	93	76
22. PRUNUS SPINOSA	99	97	67	80	117	99	107	69
61. PRIMULA VERIS	99	97	87	85	110	86	94	78
30. *Anthriscus sylvestris*	86	106	95	78	127	110	114	79
7. *Cardamine pratensis*	108	107	96	88	119	99	109	89
12. *Stellaria Holostea*	111	103	84	97	126	106	107	72
71. *Endymion nutans*	110	114	109	105	132	113	115	88
52. *Veronica Chamædrys*	109	116	104	89	122	102	115	85
62. *Plantago lanceolata*	118	110	112	113	131	114	117	101
3. *Ranunculus acris*	119	114	112	100	137	113	125	100
60. *Ajuga reptans*	127	122	127	119	139	117	128	108
16. GERANIUM ROBERTIANUM ..	125	126	124	120	143	120	128	97
32. *Galium Aparine*	128	146	144	134	155	142	143	129
17. TRIFOLIUM REPENS	138	149	154	138	162	147	146	132
24. *Potentilla anserina*	146	145	152	131	151	128	138	132
18. *Lotus corniculatus*	141	151	157	136	160	143	142	136
39. *Chrysanthemum Leucanth.* ..	137	143	141	130	155	137	142	127
46. *Hieracium Pilosella*	141	143	145	131	159	136	142	123
11. *Lychnis Flos-cuculi*	137	153	156	139	164	146	148	138
21. *Lathyrus pratensis*	154	164	167	157	169	153	156	157
5. *Papaver Rhœas*	145	152	160	154	175	167	156	143
68. *Iris Pseud-acorus*	156	163	166	148	169	162	157	146
26. *Rosa canina*	157	164	165	151	178	162	159	149
13. MALVA SYLVESTRIS	158	169	169	160	180	168	160	156
59. *Stachys sylvatica*	164	170	170	154	176	160	160	158
28. *Epilobium montanum*	166	175	170	165	176	163	161	160
23. *Spiræa Ulmaria*	173	176	174	168	188	176	180	161
42. CENTAUREA NIGRA	162	179	178	168	189	175	172	174
33. *Galium verum*	176	185	182	183	196	185	179	185
44. *Carduus arvensis*	178	182	183	176	202	183	179	184
45. *Sonchus arvensis*	191	193	205	200	211	200	189	198
49. CONVOLVULUS SEPIUM	195	195	199	189	212	194	189	190

From the above remarks it seems pretty clear that the more striking plants are better observed; in some cases this is not an advantage, as, unless well looked after, the first flowers may be gathered by children before the observer sees the plant; and consequently near towns it will be well to take frequent notes as the plants are coming into flower, and also to rely more upon the less conspicuous ones.

Of the Entomological notices sent in, but very few words need be said. At best, they are too few in number from which to draw definite conclusions.

The *Cockchafer* appeared during the latter half of May, mainly from the 12th to the 22nd.

The *Honey Bee* began working about the 14th of February, though at Totnes it was out as early as the 13th of January. There were very few swarms apparently; the earliest recorded was on the 4th of May, at Addington; another was on the 18th, at Hatton.

Large White Butterfly.—This is apparently confused with the Small White Butterfly. It is reported from Hertford as early as the 15th of March, but this is probably a mistake. Its appearances vary from the 12th of April at Sawbridgeworth to the 21st of May at Great Cotes. It occurred about a fortnight before its average date at Marlborough.

Small White Butterfly.—This was generally seen early in April; but in the Herts district not till the 21st at some places, and as early as the 18th of March at others, an interval of nearly five weeks. In the Eastern Counties it was noticed about the 18th of April. At Marlborough the first was seen as early as the 20th of March, being a fortnight before its average time.

Meadow Brown Butterfly.—There seems to be a singular variation in the records of this species. At Harpenden it is noticed as occurring on the 18th of March, at Killarney on the 15th of March, at English Bicknor on the 14th of March, and at Babbacombe on the 15th of April. As this is a June insect, there seems to be some error in the records. The other dates quoted vary from the 17th of May at Cambridge, the 11th of June at Totnes, to the 27th of June at Isleworth. At Marlborough it was seen on the 7th of June, about five days before its average date.

St. Mark's Fly.—This was seen at Great Cotes in extraordinary numbers above hedges on the High Wolds on the 15th of May, about which date it was also plentiful in Devonshire, so much so as to attract general notice.

Brimstone Butterfly.—Though a hibernating species this is well worth noticing. The Common Tortoise-shell and Peacock Butterflies come out whenever the day is warm, and their appearance therefore is only an indication of a fine warm day at that period; but the Brimstone is a more reliable insect. It was seen at Bradenham on the 12th of February, but elsewhere from the 9th to the 13th of March. At Marlborough a specimen was seen on the 26th of February, and a second on the 13th of March somewhere about its usual date.

Frog Spawn.—This was seen first at Killarney on the 18th of February, but not till the 4th of April at Ware. It was generally noticed early in March. At Marlborough it was plentiful on the 22nd of February, having been probably deposited a day or two when first noticed.

REPORT ON THE ORNITHOLOGICAL OBSERVATIONS. By the Rev. HENRY H. SLATER.

REPORTS have been received from thirty-two stations, as against forty-six in 1881, thirty-two in 1880, and twenty-five in 1879. This decrease

in their number is much to be regretted, as they require to be very largely reinforced before results of any great scientific value can be derived from them. A partial reporting of the movements of birds is apt to be misleading, as will be readily seen on referring to the accompanying table. Take, for example, the Cuckoo; the earliest record of the song of this bird, 7th of April, comes from Pomeroy, Co. Tyrone, whilst the average of twenty English stations is only the 18th of April. It might therefore be inferred that this bird migrated from West to East, instead of *vice versâ*, and was an American bird. A similar inference might be made on casting the eye down the column devoted to the Willow Wren. But if the averages could be calculated from a greatly increased number of stations, these discrepancies would disappear. It is a matter for regret that many of the reports sent in are fragmentary. Ten of them contain reference to fewer than six of the twenty birds.

In the tabulated results the Hertfordshire stations, as in last year's report, are aggregated, and the figures in the table (under the name "Hertford") based on the average of the six; the stations being, Hertford, Harpenden, Hoddesdon, Sawbridgeworth, Ware, and Watford.

Song.

Song Thrush.—The average date of song was the 14th of January, as against the 7th of February in 1881. This bird bred remarkably early this year. A nest was found containing five young birds on the 28th of January, at Belton. Nests with eggs were also recorded on the 3rd of March at Addington, the 7th of March at Marlborough and Strathfield Turgiss, the 12th of March at Hatton, and the 15th of March at St. Michael's-on-Wyre.

Many remarks have been made concerning the diminution in numbers of the Song Thrush of late years. I do not consider it justifiable to assume that its recent scarcity (which was not universal in the United Kingdom) is entirely due to the severity of a few winters of late without further and fuller information.

Nightingale.—The average date for the song is 118, the 28rd of April, as in last year. At Harpenden it was first heard on the 15th of April.

Willow Wren.—The average date of song was two days earlier than last year. In 1875, I noticed the first Willow Wren in Northumberland, on the 2nd or 12th of April, but no song until the 21st of April, and so in most years; the interval between arrival and song being reduced according to the mildness of the weather. It was seen at Great Cotes on the 27th of March, considerably the earliest record for the year.

Chiff Chaff.—The average date of song was four days later than last year. The remarks anent the differences between the arrival and song of the Willow Wren apply to this bird also; but it is more irregular in its appearance. The earliest record was the 18th of March, at Westward Ho.

Skylark.—The average date of song was the 10th of February; in 1881, 20th of February; in 1880, 20th of January. The earliness or otherwise of the Lark's note would seem to be entirely a matter of sunshine, in

TABLE III.

Station.	Song.									Migration.								Nesting.	
	Brown Owl. 80.	Song Thrush. 82.	Nightingale. 84.	Willow Wren. 86.	Chiff-chaff. 87.	Skylark. 88.	Chaffinch. 89.	Cuckoo. 91.	Turtle Dove. 94.	Flycatcher. 81.	Fieldfare. 83.	Wheatear. 85.	Swallow. 92.	Swift. 93.	Woodcock. 96.	Corncrake.	Nightjar.	Martin.	Thrush. 82.	Rook. 90.
Maker	..	..	..	..	107	..	..	..	..	..	..	..	109	132	..	..	..	..	.....	....
Babbacombe	..	..	..	..	..	..	..	115	115	..	..	..	122	..	..	..	..	..	.....	....
Westward Ho	..	..	..	..	72	..	..	..	..	..	..	81	97	93(?)	..	..	..	..	.....	....
Totnes	..	3	..	93	74	63	10	105	..	..	..	..	103	121	..	..	..	..	.....	49. Building
Wincanton	..	..	117	..	..	54	..	110	..	..	..	..	102	141	..	133	..	123	.....	61. Building
Salisbury	..	..	111	..	..	38	..	110	..	139	..	..	103	..	..	169	..	114	.....	....
Marlborough	..	..	..	..	118	42	..	111	..	..	..	101	..	127	..	122	..	..	66. Nest and eggs	50. Building
Strathfield Turgiss	..	..	100	..	..	..	..	102	125	..	..	..	104	124	..	..	..	122	66. Nest and eggs	....
Isleworth	..	..	105	..	..	24	..	105	..	..	..	..	110	..	..	..	..	..	.....	....
English Bicknor	..	..	..	..	..	..	..	112	..	..	..	..	106	..	..	..	..	..	.....	....
Bradenham	..	1	..	100	77	..	29	114	126	121	..	..	97	128	..	129	137	125	.....	....
Hertford	..	14	108	..	83	16	32	105	..	..	95	..	102	123	..	..	..	..	.....	53. Building
Malvern	..	..	..	..	..	..	..	101	..	..	..	..	124	..	..	..	..	..	.....	....
Addington	..	..	114	..	..	..	..	106	132	..	..	..	104	121	..	..	..	..	62. Nest with two eggs	55. Building
Banbury	12	14	133	102	84	35	43	..	131	141	94	..	102	129	..	131	..	109	161. Nest and eggs	63. Building
Cardington	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	.....	....
Braintree	..	..	116	..	..	..	..	106	.	..	..	..	114	..	..	..	..	..	.....	....
Geldeston	..	..	105	..	..	..	..	118	..	..	..	..	112	..	..	..	..	112	.....	....
Belton	..	..	110	..	..	..	..	110	..	..	..	..	94	130	..	..	..	..	28. Nest containing five young	61. Building
Cambridge	..	32	109	..	..	..	..	112	..	141	..	..	107	132	..	..	..	112	57. Nest complete; 62. Egg	59. Building
Doddington	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	.....	....
Hatton	..	35	..	102	..	..	45	113	..	140	72	..	110	..	..	..	..	..	71. Nest begun; 96. Young hatched	62. Building
Parbold	..	..	..	..	..	..	..	99	..	..	..	..	97	..	..	..	..	..	.....	....
Great Cotes	..	..	129	86	87	3	43	109	..	133	101	78	102	135	281	..	..	..	.....	...
St. Michael's-on-Wyre	..	..	..	..	..	..	..	117	..	146	..	..	108	..	..	113	..	116	74. Nest and eggs	64. Building
Killarney	..	16	..	95?	..	112	112	..	..	..	27	..	116	..	..	117	..	..	.....	59. Building
Pomeroy (Co. Tyrone)	..	..	..	98	..	..	..	97	..	..	18	..	..	..	..	112	..	102	.....	...
Average	..	14	113	96	87	41	44	108	125	137	67	..	105	128	..	128	..	115	.....	58

places where they do not migrate. In the North, they usually leave the interior for the neighbourhood of the coast during the winter. In Northumberland I seldom heard the Lark's note before the end of February; here in Bucks, I expect if it be fine to hear it on New Year's Day.

Chaffinch.—The average date of song in 1882 was the 13th of February, a week earlier than in 1881. The earliest record was the 10th of January, at Totnes. The song of this bird also is a good deal dependent upon sunshine.

Cuckoo.—This bird was heard on the average three days earlier than in 1881, on the 18th of April. The Cuckoo may generally be looked for on nearly the same day every year. In 1880, the 21st of April; in 1879, the 19th of April; in 1878, the 18th of April, were the average dates of song.

Turtle Dove.—The average date of song was the 5th of May, five days later than last year. The earliest record was at Babbacombe, on the 15th of April.

Migration.

Spotted Fly-catcher.—The average date of appearance was the 17th of May, four days later than in 1881. The earliest record was Bradenham, on the 1st of May; the latest, at St. Michael's-on-Wyre, on the 26th of May. In 1881, the 13th of May; in 1880, the 24th of May; and in 1879, the 19th of May, were the average dates of its appearance.

Fieldfare.—Average date of the appearance of this bird cannot be depended upon, owing to insufficiency of data. It seems to have been scarce, as in 1881, though breeding in Norway as commonly as usual, as I can testify. None were seen all the winter at Totnes nor at Hatton, and a scarcity is reported from Bradenham; this agrees with my observations in Bucks.

Swallow.—Appeared, on the average, two days later than in 1881, namely, on the 15th of April. In 1880, the 19th of April; and in 1879, the 18th of April, were the average dates. Earliest record from Belton, April the 4th, one pair only. Latest from Babbacombe (as usual) 2nd of May; and Malvern, 4th of May.

Swift.—The average date of arrival was the 8th of May, as against the 11th in 1881, the 16th in 1880, and the 11th in 1879. It was decidedly earlier than usual. It was recorded from Westward Ho on the 3rd of April; but this record must be regarded with suspicion, as being unprecedented.

Woodcock.—Data insufficient.

Nesting.

Rook.—The average date of commencing to build was the 28th of February.

Thrush and Partridge.—Observations were insufficient for the formation of any satisfactory judgment.

DISCUSSION.

Mr. Mawley observed that Mr. Preston had treated the mild winter as the most important feature generally of the past phenological year, and with this he

was disposed to agree. In the neighbourhood of London, however, the spring quarter was the more remarkable. It was many years since the mean temperature of the spring had been as high: and what was perhaps of almost as much importance, the lowest temperature was higher than the extreme minimum of any spring of late years. The rainfall, again, was but little below the average, and moreover was distributed with fair regularity over the three spring months; while the atmosphere was humid rather than otherwise, and the duration of bright sunshine above the average. All the conditions were therefore favourable to luxuriant growth. On the 29th of April, however, there occurred a gale, which as regarded the wholesale destruction of leaves and blossoms of trees, and indeed of all vegetation exposed to its direct influence, was in his experience unprecedented. For some time afterwards the windward side of those trees, the foliage of which was sufficiently advanced to be affected, appeared as if blackened by fire, whilst the sheltered side was unscathed. Later on all this was changed, so that only the usual dull green leaves of mid-summer were to be seen on the north side, while the south or injured side bore the fresh green foliage of spring. In many cases these new leaves were slow in appearing, owing to the severe shock the trees had themselves sustained through their untimely defoliation; and the effect of this was to leave them greatly open to the attacks of blight, caterpillars, and other insect pests. Only a few weeks ago a third result of this gale was apparent, for while the injured trees, and particularly oaks, had scarcely a leaf left upon them, those few which had escaped the storm continued in such active growth, owing to the cool summer and wet autumn, as to retain nearly the whole of their foliage, the dead leaves clinging to the still unripened wood. It would be, as remarked in one of the horticultural papers at the time, interesting in years to come to trace in felled timber the influence of this storm upon the thickness of the layer or layers of wood which had been formed during the current year. Mr. Mawley was pleased to find that Mr. Preston in no way attributed the damage to trees either to the deposit of salt spray upon their young foliage, or to the action of frost, but had happily described the leaves as simply "beaten to death" by the wind. It had been popularly supposed that the salt which fell during this gale occasioned much of the mischief, and even so keen an observer of nature as the Poet Laureate appeared to have held this opinion, for in his new drama of "The Promise of May" he spoke of a "salt wind" which "burnt the blossoming trees." Whereas the long-continued violence of the wind was in itself sufficient to account for all the damage done to the tender young leaves. At Addiscombe a velocity of thirty-six miles an hour was on this occasion maintained for six consecutive hours, and at Kew some of the individual gusts were stated to have attained a rate of between seventy and eighty miles an hour. In fact, Mr. Eaton had noticed that much injury had been done to the foliage of several chestnut and pear trees in Croydon before any salt had been deposited, and some time before the storm had reached its height. In another part of Mr. Preston's report an instance had been given of even the comparatively tough leafage of autumn having been killed by the violence of the wind during the severe storm of October 1881.

PROCEEDINGS AT THE MEETINGS OF THE SOCIETY.

NOVEMBER 15th, 1882.

Ordinary Meeting.

JOHN KNOX LAUGHTON, M.A., F.R.G.S., F.R.A.S., President, in the Chair.

Rev. JOSEPH BRUNSKILL, Threlkeld, Keswick;
FRANK B. BUCKLAND, Windsor;
CHARLES FREDERICK CASELLA, The Lawns, Highgate, N.;
WILLIAM HENRY MAHONY CHRISTIE, M.A., F.R.S., Astronomer Royal, Royal Observatory, Greenwich, S.E.;
RICHARD SPELMAN CULLEY, St. Martin, Weston-super-Mare;

CHARLES MORRIS, 5 Seymour Terrace, Plymouth;
OWEN LIVINGSTONE O'CONNOR, Verdun, Mauritius;
HENRY PARKER, F.Z.S., 19 Hanover Square, Bradford;
ALLAN ROWNTREE, Westwood, Scarborough; and
DANIEL RADFORD SHARPE, Bocking, Braintree,
were balloted for and duly elected Fellows of the Society.

The following Papers were read :—

"ON CERTAIN TYPES OF BRITISH WEATHER." By the Hon. RALPH ABERCROMBY, F.M.S. (p. 1.)

"ON THE USE OF KITES FOR METEOROLOGICAL OBSERVATION." By Professor E. DOUGLAS ARCHIBALD, M.A., F.M.S. (Abstract.)

IN this Paper the author draws attention to the importance of knowing the physical conditions of the upper regions of the atmosphere, and the limited extent of knowledge respecting them. The adaptability of balloons and mountain peaks as *points d'appui* for observation is then contrasted with that of kites, and it is shown that balloons are very expensive, that they shift their position too rapidly, when free, to give data at a fixed point in space, and that when captive they are too sensitive to wind. Wind, which is thus an obstacle to the employment of balloons, is favourable, and indeed indispensable, to the elevation and use of kites. Isolated mountain peaks are better than balloons; but their number is too limited to enter into competition with means which would be universally available except in the case of a dead calm above as well as on the surface. The use of kites is therefore advocated in preference to either of the above methods, for sounding the atmosphere up to moderate or even great heights. The various observations which can most conveniently be made with kites may be briefly referred to under the following heads :—

(1.) A kite or series of kites, flown *tandem*, *i.e.* one above the other, shows the direction of the wind in the stratum or strata in which it or they are flying, and which is often very different from that at the surface of the earth.

(2.) By attaching anemometers or thermometers to the kite string at intervals, the velocity of the wind or the temperature of the air may be measured at different elevations.

(3.) By a tension-gauge the pressure of the wind on the kite, and therefore at its altitude, may be calculated.

(4.) The height of clouds can be determined by measuring the height of the kite at the moment of its obscuration.

(5.) Kites may be used possibly for measuring the electric potential, amount of ozone, &c.

In any case, whether, as likely, the actual observations would be wanting in the accuracy attainable at fixed observatories, relative observations might be taken, which would probably help to throw light on several hitherto disputed points, as well as yield fresh data of considerable value.

An apparatus for letting-out and winding-in kites, designed by the author, is next described, and its collapse when the drum was by mistake made hollow adverted to, as exemplifying the enormous pressure on the kite.[1]

The tails of the kites are self-regulating, and are constructed of canvas cones, 4 ins. wide, 6 ins. deep, and connected together by wire to prevent twisting and unraveling. Four such cones at long intervals suffice for an 8 ft. kite. The height attained by kites in experiments made by the author has not as yet been accurately measured, but is inferred to have been about 2,000 ft. Owing to the collapse of the winder, the experiments, which were only in a preliminary stage, were suddenly brought to a termination; but the author hopes to renew them again next year, and that other Fellows may be induced to join him in this new field of inquiry.

[1] The drum has now been reconstructed with a solid wooden reel.

The following table, calculated from the ordinary formula connecting wind-pressure and velocity, $p = \cdot 005\ v^2$, gives the maximum tensions to be allowed for under varying conditions of wind-velocity and kite-inclination :—

Velocity of wind in miles per hour.	Area of Kites.					
	20 sq. ft.			30 sq. ft.		
	Angle of inclination to horizon.			Angle of inclination to horizon.		
	30°.	45°.	60°.	30°.	45°.	60°
	Tension in lbs.			Tension in lbs.		
20	20	28	34	30	42	51
25	31	44	52·7	46·5	66·5	79
30	45	64	76·5	67·5	96·5	114·6
35	61	87	103·7	91·5	130	155·4
40	80	152	136	120	168	204

Mr. STRACHAN said several of the Arctic explorers had experimented with kites. It might be desirable to ascertain how these were made, and what gear was used with them. Admiral Back, when in command of the *Terror*, used a kite to obtain the temperature of the upper air in Hudson's Strait.

Mr. WHIPPLE referred to experiments with a kite by the late Sir Francis Ronalds at Kew, a short account of which was to be found in the *Philosophical Magazine*, Vol. XXXI. 1847, p. 191. With respect to determining the height of clouds, Captain Abney, F.R.S., had recently successfully applied photography to this purpose. Two cameras, at a known distance apart, and in electrical communication with each other, to enable the photographs to be taken simultaneously, were placed so as to obtain different views of the same cloud, and its height was ascertained by a comparison between the two photographs. The force of the wind on kites was enormous, and he had read in the *Boys' Own Paper*, Vol. III. p. 57, that kites had been used in 1827 for drawing carriages on common roads, and a journey had been made from Bristol to London in a vehicle drawn by their aid at a rate of twenty-five miles per hour, the kites being steered by strings attached to their wings.

Mr. LECKY said that a journey from Bristol to London in a carriage drawn by kites was made in the year 1862.

"THE METEOROLOGY OF MOZUFFERPORE, TIRHOOT, 1881." By C. N. PEARSON, F.M.S. (p. 25.)

Mr. S. G. DENTON, F.M.S., exhibited a number of Thermometers which were said to be not subject to change of zero.

DECEMBER 20th, 1882.

Ordinary Meeting.

JOHN KNOX LAUGHTON, M.A., F.R.G.S., F.R.A.S., President, in the Chair.

RICHARD LADD, 106 Sandgate Road, Folkestone ;
ALFRED ELEY PRESTON, Belle Vue, Manningham, Bradford ; and
ALEXANDER WILLIAMSON STIRLING, M.B., Westfield House, Stapleton,
were balloted for and duly elected Fellows of the Society.

CAPT. J. C. DE BRITO CAPELLO, Director of the Observatory of the Infante don Luiz, Lisbon; and
WILLIAM FERREL, M.A., U. S. Coast Survey, Washington,
were balloted for and duly elected Honorary Members of the Society.

Mr. J. S. HARDING and Mr. H. S. WALLIS were appointed Auditors of the Society's Accounts.

The following Papers were read:—

"POPULAR WEATHER PROGNOSTICS." By the Hon. RALPH ABERCROMBY, F.M.S., and WILLIAM MARRIOTT, F.M.S. (p. 27.)

"REPORT ON THE PHENOLOGICAL OBSERVATIONS FOR 1882." By the REV. T. A. PRESTON, M.A., F.M.S. (p. 47.)

Mr. J. S. DYASON, F.M.S., exhibited (1) twenty sketches of typical clouds in monochrome, and (2) a series of sketches of skies and clouds, in oil and water-colour, made mostly in the North-west of London during 1882.

CORRESPONDENCE AND NOTES.

COMPARISON OF THERMOMETER SCREENS.

THE "Report on the Experiments made at Strathfield Turgiss in 1869 with Stands or Screens of various patterns, devised and employed for the exposing of Thermometers, in order to determine the Temperature of the Air," by Mr. F. Gaster, has just been published by the Meteorological Office.[1] These experiments were started at the instigation of Mr. Symons, who obtained a grant from the Royal Society to defray the cost of the same. The observations were carried on at Strathfield Turgiss by the Rev. C. H. Griffith, who took readings of all the instruments at 9 a.m., 3 p.m., and 9 p.m., from November 1868 to April 1870. The screens experimented with may be classified as follows:—

Open Screens:—Glaisher, James, Lawson, Pastorelli, and Stow.
Intermediate Screens:—Griffith and Martin.
Closed Screens:—Kew and Stevenson.
Wall Screen:—Morris.

A thermometer suspended in the open air at a height of 24 ft. above the ground, and an aspirated thermometer placed on the Lawson stand, were also used.

From an examination of the monthly means of temperature grouped according to the state of the weather, the following broad features come out clearly:—

1. That in winter, and especially in overcast weather, when the sun's power is slight, and when terrestrial radiation is greatly checked, the indications of the stands agree very closely.
2. That as the sun's power increases, and during clear bright weather at nights, considerable differences manifest themselves, the open screens (and especially Pastorelli's and Lawson's), when compared with the closed screens, giving indications considerably in excess during the day, and in defect during the night.
3. That certain irregularities noticed from time to time are probably dependent on rapid changes of temperature during clear weather, and which occur during the time necessarily occupied in reading so many sets of instruments; while there are others on which the present series of experiments throw no light.
4. That the freely-suspended thermometer gives readings in excess of the closed (and often of all) screens during the day, but agreeing very well with the closed screen at 9 p.m.

[1] *The Quarterly Weather Report* 1879, Appendix II., London 1882. 4to.

5. That the aspirated and non-aspirated thermometers read considerably higher than those in the closed screen (often higher than those on any screen) during the day, and lower at the night observations.

The following conclusions are drawn from the indications of the daily maximum and minimum temperatures :—

1. In most of the winter months slightly higher maxima and lower minima temperatures are recorded on the open and Griffith's stands than in the closed stands.

2. The difference increases as the sun's power increases, so that while in winter[1] the values for maximum temperatures, in the more generally used of the open stands (*i.e.* Glaisher's and James'), differ only a few tenths of a degree from those given by the closed stands, yet in summer the mean difference exceeds 1°·5, and on individual occasions is still greater.

3. That the difference between the minima in winter as compared with summer is not so large as the corresponding maxima.

4. That the mean ranges in Pastorelli's, Lawson's, and Griffith's stands are far greater than in the closed stands, and are also greater than in other open stands.

5. That the indications in the Kew and Stevenson's stands (the only closed stands tried) agree closely, the range being only slightly less in the former than in the latter during summer.

6. That the maximum readings in Martin's screen are very similar to those in the closed screen, except in the height of summer, when the former are higher. The minima are usually higher than in the closed screen.

7. That the wall screen (except when affected by the direct solar rays) is sluggish, giving maxima considerably below, and minima considerably above, the screens in the open.

8. The suspended thermometer gives indications in excess of those in the closed, and in most of the open, screens so long as the sun is shining, but at 9 p.m. its readings agree closely with those in the closed screens.

As the instruments on the open stands are most exposed to radiation and the reflection of heat, Mr. Gaster came to the conclusion that these are faulty in recording too large a range of temperature. He, therefore, chose the closed screens as standards, with which finally to compare the readings in the other stands. Looking at the close agreement of the two specimens tested, and their comparative bulk and expense, he has concluded that Stevenson's screen is better adapted than any of the others for registering the temperature of the air.

Comparison of Standard Barometers of Foreign Scientific Institutions with the Normal Barometer of the Meteorological Central Office of Italy, by Dr. Ciro Chistoni.

Dr. Chistoni[2] has compared the standard barometers at the principal observatories of Europe, and taking the absolute standard of St. Petersburg as the basis for his comparison, he finds their errors, relative to this instrument, are as follows :—

Barometer.	Mm.	Ins.
Hamburg, Fuess, No. 9	−0·35	−0·0138
,, Fuess, No. 5	−0·14	−0·0055
,, Fuess, No. 10	−0·22	−0·0087
Berlin, Old Standard, by Greiner	−1·16	−0·0460
Copenhagen, Jünger	−0·11	−0·0043
Rome, Deleuil, No. 6	−0·22	−0·0087
Stockholm, Pistor and Martins, No. 579	0·00	0·0000
Vienna, Pistor	−0·17	−0·0067

[1] January is quite exceptional to the other months; in that month the maxima are lower on the Glaisher's than on the Stevenson's stand.

[2] *Annali della Meteorologia.* Parte I. 1881-1882. 4to.

His first comparison with the Kew Standards was an indirect one, made by means of a Negretti and Zambra's Standard, No. 1042, which he found at Pesaro, and which had been compared at Kew in 1877. By means of an indirect comparison of this instrument with the Standard, Deleuil No. 6, at Rome, he found the error of the latter, so referred to the Kew Standards, to be —0·23 mm. (—0·0090 in.). Subsequently, Professor Tacchini conveyed another barometer directly to Kew, and this, when compared with the Roman Standard, indicated the difference between the two instruments to be —0·19mm. (—0·0076 in.). From these two comparisons he assumes the true error of Deleuil to be —0·21 mm. (—0·0084 in.). Having already determined the error of that instrument referred to the St. Petersburg Standard to be —0·22 mm. (—0·0087 in.), he concludes that the two absolute Standard Barometers of Kew and St. Petersburg perfectly agree, and taking into account possible error of reading the instrument at Rome, "they cannot differ between themselves more than half the tenth of a millimetre (·002 in.)." With the absolute Standard of the Collége de France he found the error of Deleuil No. 6 to be —0·18 mm.(—0·0071 in.). Hence he also concludes that the absolute Standard Barometer of the Collége de France perfectly agrees with the absolute Standards of Kew and St. Petersburg within the limits of the half tenth of a millimetre (—·002 in.).

Finally, he concludes that the mean error of the Standard of the Central Meteorological Office of Italy is —0·20 mm. (—0·0080 in.), and that this is entirely due to the ivory pointer in the cistern of that barometer.

A subsequent comparison with the Kapeller barometer of the Meteorological Institute at Vienna showed that instrument to have an error of +0·06 mm. (+0·0024 in.) within the limits of half a tenth of a millimetre.

G. M. W.

RECENT PUBLICATIONS.

AMERICAN JOURNAL OF SCIENCE. Vol. XXV. January, 1883. 8vo.

Contains:—Contributions to Meteorology, by Prof. E. Loomis. Eighteenth Paper, with a map (18 pp.). In this Paper the author deals with: 1. Mean annual rainfall for different countries of the globe. A table is given showing the mean annual rainfall at 323 stations; and with the aid of these new materials, Prof. Loomis has prepared a revised rainfall map of the globe. 2. Relation of rain areas to areas of low pressure. From this discussion it appears that cases of very heavy rainfall in Europe almost invariably occur within or near an area of low pressure, but a great rainfall is frequently due to a local cyclone of moderate extent formed within or near to a large area of low pressure. These rainfalls most frequently occur on the east side of an area of low pressure.

ANNALI DELLA METEOROLOGIA. Parte I. 1881. 4to. 1882.

Contains:—Osservazioni dei Temporali raccolte nel 1880 e relativo studio pel Dr. C. Ferrari (256 pp. and 40 plates). This is an elaborate discussion of the thunderstorms which occurred in the provinces of Piedmont, Liguria, Lombardy, Venetia, Emelia, the Marches, Tuscany, Umbria and Latium. Observations were collected from 574 stations. The period discussed was from April 30th to September 17th, 1880.

ANNUAIRE DE LA SOCIÉTÉ MÉTÉOROLOGIQUE DE FRANCE. 30me Année, 1882. Mars. 4to.

Contains:—Note sur une observation barométrique faite le 17 janvier 1882, à Poitiers, par M. de Touchimbert (2pp.).—Note sur l'hiver de 1881-1882, par M. E. Renou (2 pp.).—Manuel de la prévision du temps à Bar-le-Duc, par M. Poincaré, 2me partie, chapitre 6, Pluies et neiges (5 pp.).—Variations de la température avec l'altitude dans le bassin de la Seine, pendant la période des hautes pressions du mois de janvier 1882, par G. Lemoine et A. de Préaudeau (2 pp.).

ASSOCIAZIONE METEOROLOGICA ITALIANA. ATTI DELLA PRIMA RIUNIONE METEOROLOGICA ITALIANA pubblicati per cura del comitato Direttivo Provvisorio dell' Associazione. 8vo. 1881. 185 pp.

This is a report of the proceedings at the first gathering of the Italian Meteorological Association, which was held at Turin from September 1st to 4th, 1880. The appendix contains a number of papers, among which are :—Discorso di apertura del P. F. Denza (9 pp.).—Sulle osservazioni delle nuvole del Prof. H. Hildebrandsson (3 pp.)—Sui fenomeni periodici che succedono nella vita delle piante e degli animali del Dr. C. De Giorgi (13 pp.).—Sul servizio dei temporali in Italia nel quinquennio 1876-80, del Prof. P. Frisiani (5 pp.).—Proposte sulle determinazioni altimetriche, del Prof. G. Marinelli (4 pp.).—Nefoscopio del P. F. Cecchi (6 pp.).—Nefodoscopio del Prof. C. Fornioni (3 pp.).

BOLETIM DA SOCIEDADE DE GEOGRAPHIA DE LISBOA. 8A Serie, Nos. 5-6. 8vo. 1882.

Contains :—Observatorio Meteorologico de Loanda. Observaçoes de 1879-1881, por G. G. Coelho (25 pp.). The results of these three years' observations show that the mean annual temperature is 73°·4, and the rainfall 12·5 ins. The maximum temperature during the period was 89°·1 on November 25th, and the minimum 56°·3 on June 23rd and 24th, 1879, and August 7th and 23rd, 1880.

BULLETIN DE LA SOCIÉTÉ KHÉDIVIALE DE GÉOGRAPHIE. Série IIme. No. 2. 8vo. 1880.

Contains :—Sur la nécessité d'établir des stations Météorologiques en Egypte, par S. E. Mahmoud-Pacha-el-Falaki (4 pp.). The author calls attention to the lack of meteorological observations in Egypt, and recommends the establishment of five stations, viz. one of the first order and four of the second order.

CIEL ET TERRE—REVUE POPULAIRE D'ASTRONOMIE ET DE MÉTÉOROLOGIE. Troisième Année. Nos. 17-22. November 1882—January 1883. 8vo.

Contains :—Une particularité de l'aurore boréale du 2 Octobre 1882 (8 pp.).—Les inondations de Novembre 1882 (3 pp.).—La prévision du temps (10 pp.).—L'aurore boréale du 17 Novembre, 1882, en Belgique (3 pp.).—Observations de Nuages (4 pp.).

ELEMENTARY METEOROLOGY. BY ROBERT H. SCOTT, M.A., F.R.S., Secretary to the Meteorological Council. With numerous illustrations. International Scientific Series. Vol. XLVI. 8vo. 1883. 408 pp.

This book has been compiled in order to supply the long felt want of a simple text-book of Meteorology. The work is divided into two parts. Part I. after a short preliminary notice of the earth itself, and its atmosphere, gives a description of the various instruments and the modes of using them; while Part II. is devoted to an account of the geographical distribution of the different phenomena. The book is illustrated by forty-four engravings and eleven plates.

GLI STUDI IN ITALIA. An. V., fasc V., Vol. I. 1882. 8vo.

Contains :—La Meteorologia e la Fisica Terrestre al III. Congresso Geografico Internationale di Venezia, Relazione del P. F. Denza (27 pp.).

JOURNAL AND PROCEEDINGS OF THE ROYAL SOCIETY OF NEW SOUTH WALES, 1881. Vol. XV. 8vo. 1882.

Contains :—The Climate of Mackay, by H. L. Roth (20 pp.). Mackay is a port on the East coast of Australia, in the colony of Queensland on the Pioneer River, the centre of a rich and thriving sugar-growing district. The author gives a summary of the observations made during the five years 1876 to 1880.—The Appendix contains an Abstract of the meteorological observations taken at the Sydney Observatory (12 pp.), as well as a Rainfall map of New South Wales for the year 1881, by H. C. Russell.

NEW SOUTH WALES IN 1881: being a brief statistical and descriptive account of the Colony up to the end of the year, extracted chiefly from Official Records. Published by Authority. Compiled and edited by THOMAS RICHARDS. Second Issue. 1882. 8vo. 144 pp. and Map.

The climate is referred to as follows:—Great diversity of elevation and a stretch over nine degrees of latitude at a favourable distance from the Equator offer every variety of temperature and humidity in New South Wales, from the cold of the North of Scotland to the warmth of Southern Italy; the mean shade temperature of Sydney is 62°·6, and is very near the mean temperature of the Colony. With regard to moisture, which is such an important factor in climate, one may enjoy the balmy and humid air of the Clarence which is tropical in its character, or the bracing climate of the Tablelands, with a mean temperature of 55°, and a minimum sometimes down to 22°, and the attendant abundant snows of winter; but not a single locality in the whole expanse can be pronounced unhealthy. So pure is the atmosphere in the districts where the thermometer shows the highest readings that the heat is never intolerable, whilst during at least six of the twelve months the climate is delightful. Dry seasons come in this as in other countries at uncertain intervals, but the settlement of the interior is not only increasing the water in creeks and rivers, but bringing with it such a multitude of reservoirs for preserving the abundant rains, and of wells for getting water from below, that droughts are no longer the terror they used to be.

PROCEEDINGS OF THE ROYAL SOCIETY. Vol. XXXIV. No. 222. 1883. 8vo.

Contains:—Sun-spots and Terrestrial Phenomena. I. On the variations of the daily range of atmospheric Temperature, as recorded at the Colába Observatory, Bombay, by C. Chambers, F.R.S. (17 pp.).—Monthly means of the highest and lowest diurnal Temperatures of the water of the Thames, and comparison with the corresponding Temperatures of the air at the Royal Observatory, Greenwich, by Sir G. B. Airy, F.R.S. (9 pp.). These observations extend over a period of thirty-five years, and were taken at the 'Dreadnought' Hospital Ship off Greenwich from 1844 to 1870, and at a police-ship moored in Blackwall Reach from 1871 to 1879. The results show that the mean temperature of the Thames water is higher than that of the Observatory thermometer by 1°·5, but the difference is not uniform through the year. The tide appears to have but little effect upon the temperature, as the mean daily range is only 2°·1. Sir G. Airy does not imagine that the tidal action has any beneficial effect on the climate of London, except that probably the agitation of the water produces mechanical agitation of the air, and thus destroys injurious stagnation.—Report of the Kew Committee for the year ending October 31, 1882 (23 pp.).

SYMONS'S MONTHLY METEOROLOGICAL MAGAZINE. November 1882-January 1883. Vol. XVII. Nos. 202-204. 8vo.

Contains:—Is the Royal Charter Gale periodic? (2 pp.).—On the origin of Hail, by Prof. T. Schwedoff (translation) (6 pp.).—Hailstorm at Ober Grainau, Bavaria, 4th June 1882, by Col. M. F. Ward (4 pp. and 2 plates).—The recent Auroræ (3 pp.).—The recent floods in Western Europe (6 pp.).

THE WEATHER OF 1882 AS OBSERVED IN THE NEIGHBOURHOOD OF LONDON, and compared in all respects with that of an average year. By EDWARD MAWLEY, F.M.S., F.R.H.S. With Tables of Daily Observations and a Diagram. 8vo. 1883. 75 pp.

The author summarises the chief features of the year as follows:—During the greater part of the first two months the barometer remained singularly high, and on January 18th attained a point unprecedented in this country. These mild winter months were followed by three other warm and bright ones; indeed last spring, taken as a whole, was a most genial and brilliant season, though unfortunately marred by a gale which, as regards its injurious effects on the blossoms and foliage of trees, is perhaps unparalleled. With the advent of summer there came, however, a complete change of weather, each of its three months proving,

in a greater or less degree cold, dull, damp and windy. October was a particularly wet month, and after this to the close of the year rain fell almost every day. The clearness of the atmosphere in November and its freedom from fogs were very unusual, while equal terms of unseasonably cold and mild weather at its commencement and close marked the last month of the year. Taking 1882 as a whole, the chief features were its long sustained damp and windy atmosphere.

TRANSACTIONS OF THE HERTFORDSHIRE NATURAL HISTORY SOCIETY AND FIELD CLUB. Vol. II. Part 2. November 1882. 8vo.

Contains :—Meteorological Observations taken at Throcking, Herts, during the year 1881, by the Rev. C. W. Harvey (8 pp.).—Meteorological Observations taken at Wansford House, Watford, during the year 1881, by John Hopkinson (7 pp.).—Report on the Rainfall in Hertfordshire in 1881, by the Rev. C. W. Harvey (7 pp.).—Report on Phenological Phenomena observed in Hertfordshire during the year 1881, by John Hopkinson (9 pp.).—Notes on Insects observed in Hertfordshire during the year 1881, by Miss E. A. Ormerod (3 pp.).—Notes on Birds observed in Hertfordshire during the year 1881, by John S. Littleboy (9 pp.).

ZEITSCHRIFT DER ÖSTERREICHISCHEN GESELLSCHAFT FÜR METEOROLOGIE. Redigirt von DR. J. HANN. XVII.-XVIII. Bande. November 1882-Jänner 1883. 8vo.

Contains :—Beitrag zu der Periodicität des Polarlichtes, von Prof. H. Fritz (5 pp.).—Berechnung der Niederschlagsmengen bei Mischung feuchter Luftmassen von verschiedener Temperatur, von J. M. Pernter (6 pp.).—Phänologisches, von Prof. H. Hoffmann (4 pp.).—J. Hann über den Föhn in Bludenz. Besprochen von Dr. W. Köppen (7 pp.). — Ueber monatliche Barometerschwankungen, von Dr. W. Köppen (13 pp.).—Ueber die Anwendung der Bessel'schen Formel in der Meteorologie, von Prof. K. Weihrauch (19 pp.).

QUARTERLY JOURNAL

OF

THE METEOROLOGICAL SOCIETY.

VOL. IX. No. 46.

AN ADDRESS DELIVERED AT THE ANNUAL GENERAL MEETING, JANUARY 17TH, 1883. By JOHN KNOX LAUGHTON, M.A., President.

THE Report of the Council which has just been read, has very fully informed you of the present state of the Society and reminded you of its work during the past year. You will probably also have noticed that, in that Report, the Council has asserted the necessity and value of its action with respect to the observations taken under the Society's auspices. For myself, I feel no doubt about the matter: the discussion of observations and the elaboration of theories must be the work of the individual student; in that, the Society, in its corporate capacity, can render little help; but what the Society can do, what it ought to do, what, to a great extent, I am happy to say, it does do, is to provide the observations without which no discussion is possible, no theory can have a secure foundation. This, it seems to me, is the proper work of the Society; for this, collective effort is needed; and whether by means of its own observers, by the industry of its own staff, or by the friendly relations which it maintains with other kindred societies, this is the work which the Society is doing, even with a heavy strain on its very limited resources.

No doubt observations accumulate. Many of them may perhaps never be used; but it is impossible to weed these out beforehand; they must all grow together; and by-and-by, when the true theories of climate, of season and of weather are being worked out in minute and exact detail, we, or those who come after us, will reap the meed of self-approval, in the feeling that our steady labours have cleared the way to the result; and that the man —whether his name is to be any of those which even now are household words to the meteorologist, or some combination of letters yet unknown to

fame—this man who shall solve the great problems before us, must rest his calculations on data which we, and our sister societies in different parts of the world, have collaborated and collected.

I may thus permit myself to express my special gratification that we have been able to take the double series of observations at Boston: I cannot doubt that, even now, when these observations come to be discussed, the result will be in a very high degree interesting and important; and, though differing in nature, worthy of being compared with that splendid work which the Meteorological Office is now engaged in with respect to the weather of the North Atlantic, or with what we may hope from the summit of Ben Nevis when our energetic Fellow, Mr. Wragge, or his successor, has been able to continue his observations through the stormy months of winter.

It is not, however, only in taking and supervising these ordinary observations that the work of the Society lies. Other observations, of a more exceptional, and more costly nature, are urgently needed; observations beyond the power of the Society to undertake, but in starting which, it might perhaps serve as the fulcrum or point of support for that lever of public opinion which is wanted to raise the requisite funds. Money is the great need: but when a country such as this, with a larger shipping interest than all the rest of the world three times told, and with its farmers each year crying out on the failure of the hay and of the harvest, thinks that the Meteorological Office is adequately maintained by a yearly grant of £15,000 —or one-tenth of that assigned by the United States—the rousing of public attention is a need still greater. This is a work fairly within the province of our Society. But besides this there are other points bearing on practical meteorology concerning which it may be required to express an opinion; points about which there is confessedly diversity, difficulty or obscurity; and in which the weight of authority may guide or suggest even where it does not rule.

You are already aware that, during a considerable part of the past year, my own studies have been directed towards Anemometry, the historical results of which have been laid before you in a recent number of the *Quarterly Journal*. In pursuing these studies I have been continually reminded not only of the extreme uncertainty in which we are respecting the force or velocity of wind, but also of the curious license which prevails among observers of these elements. There is no recognised standard anemometer. I do not know that there is any really trustworthy comparison between different anemometers. It has, for instance, been shown that the pressure of wind on a plate does not vary as the area; but nothing has ever been certainly determined as to the measure or the cause of the irregularity, which may be due to the very unequal force of the direct stream-lines of the wind, or to the very different nature of the deflected currents, or to the different degrees of the vacuum in rear of the plates. It has, again, been shown that an oblong plate, a square plate and a round plate, of the same area, do not register the same pressure; and though it has been conjectured that the difference is due to the difference in the perimeter,

which is less for a circle than for a square, less for a square than for an oblong, I do not think it has ever been proved by direct experiment, nor do I think it has ever been determined whether the differences are always in the same direction. It would be very easy, by scalloping the edge, to increase the perimeter almost indefinitely, without seriously disturbing the compactness of the area: does such scalloping affect the indicated pressure in any regular way? and why should one length of perimeter be preferred to another? why should one unit of area be preferred to another?

The earlier pressure-plates, as used by Bouguer, were 6 ins. square, that is, with an area of one-fourth of a foot; those used by Mr. Osler—as also by Mr. Cator—are, I believe, all circular, but with an area varying, in different instruments, from one foot to four feet. As the plates have been changed backwards and forwards, without any special care, we have no guarantee whatever that the observations are comparable amongst themselves.

Mr. Osler is, however, of opinion that the pressure-anemometer, with which his name is associated, does show the actual pressure within very moderate limits of error: Professor Stokes, on the other hand, is of opinion that it registers 80 per cent. too much. That the trained scientific acumen of the one should be at variance with the long experience of the other, and that we should have no means of determining which is correct, but are left to pin our faith on the personal authority of one or the other, is not a satisfactory state of things. Professor Stokes is willing to consider a simple Lind's tube as giving a standard measure of wind-pressure, and it is from this that he derives his estimate of the error of the ordinary pressure-plate; but is it quite certain that the assumed hydrostatic standard does not register too low? that a measurable amount of pressure is not absorbed by the bend at the mouth, or by the friction against the sides of the tube?

The coefficients of Robinson's Anemometers are in the same state of uncertainty. That they differ with the length of the arms and the size of the cups, is known; it is also known that they differ in a strong gale and in a gentle breeze; presumably in every different wind that blows: but hitherto, the only practical application of this knowledge is that the arms are made of every possible length, the cups of every possible size, and that one coefficient, 3, is used for all instruments under all circumstances. I do think it time that meteorologists should decide some of these questions; and that, by adopting some standard instrument, with positively determined coefficients, with some defined exposure, and at some definite height, they should agree on what is meant by wind-pressure or wind-velocity. As it is, speaking generally, the observations taken at different places, or even those taken at the same place with winds from different directions, are not comparable; nor are they such as at any future time can be compared with any future standard. I had at one time hoped that it might fall to the Council this evening to announce to you that it had been able to undertake a systematic investigation of this vexed and most important problem: but, as you have already heard, it has been found necessary to postpone this for the present. I trust only for the present, and that, before very many anniversaries, the Council will have some more satisfactory intelligence to convey to you.

There is another point closely related to anemometry, which may, by some, be considered of almost more direct meteorological interest than the pressure or velocity of wind as we ordinarily understand the word; of wind, that is, near the surface of the earth. It is, of course, such wind that blows down our trees or our chimneys; that swells the sails of our ships, or occasionally hurls those ships to destruction: it is such wind that broods over the ocean, and bearing thence its warmth and its moisture, gives rise to some of the most marked peculiarities of our climate. Everywhere indeed are climatic changes effected by the wind; and heat or cold, dryness or humidity, sunshine or cloud, would all seem to depend more directly on the wind than on the season of the year.

I dwell on this, because it has been distinctly overlooked by a popular exponent of science, who, in a lately published article[1] which I daresay most of you have read, has argued that the cold snaps with which we are disagreeably familiar, are probably due to the passage of the Earth, in its orbit, through a meteoric shadow. It is not for me, on an occasion like the present, to examine in detail into this theory, which may possibly commend itself more to the astronomer than to the meteorologist: but I may be permitted to remind you that in England and in Western Europe the cold spells in April, in May, and in June are introduced and accompanied by a North-east wind; and that in Paraguay and the valley of the Amazon the cold spell in May or June is, in a similar manner, accompanied by a Southerly wind: in each case the cold is immediately due, not to the hypothetical shading of the sun's warmth, but to the actually observed intrusion of cold air from polar regions, or possibly from upper strata. Whether the supposed microscopic meteors have anything to do with this intrusion of cold air, or with the change of wind which produces it, is a question which has not come within the scope of the Paper to which I refer.

It is then, in this way, not only from its relation to the necessities of every-day life, to the requirements of the architect, the engineer and the navigator, but also from its close connection with weather changes, and from its strongly marked climatic effect, that every inquiry about wind,—by which we commonly mean the movement of air in the lower strata of the atmosphere,—has a very great claim on our attention. But in addition to this, the inquiry into the movement of air in the upper strata is calculated to throw light on the theory of cyclones, and other important problems of atmospheric circulation. We all know the attention which, for several years past, our Fellow and late Vice-President, the Rev. W. Clement Ley, has paid to this branch of meteorology, as illustrated by the movements of clouds, and the very great stress which he lays on cloud observations. It is, perhaps, impossible to over-estimate the value of these observations; but in interpreting them, and seeking for a guide to their true meaning, we are met by the difficulty that we rarely know the height of the clouds, and that it is practically impossible to measure it.

[1] "The Earth in Meteoric Shadow," by R. A. Proctor: in *Longman's Magazine*, December, 1882.

For the use of clouds as weather prognostics, the knowledge of the absolute height is not of the first importance; and Mr. Ley, by the aid of a life-long experience, would seem to manage very well without it. For questions of movement, however, and of the translation of large volumes of air, it is desirable not only to have at our command something more convenient than clouds, but to be able to determine the exact height at the moment of observation.

The summits of mountain peaks are clearly of very exceptional utility; nor can the wind, which passes over them, be considered perfectly free from the friction of the earth's surface, or from the deflection caused by the mountain masses. Balloons, again, which have been taken advantage of for this purpose, and have, from time to time, given extremely valuable indications of the velocity of wind at a high level, are too costly for general and frequent use. Mr. Archibald has also proposed attaching small current-meters to kites; but I do not know that his proposal has as yet taken any definite form.

Attempts too have been made, amongst others by Mr. Thomas Stevenson, by Dr. Vettin, and within the last few days by Mr. Archibald,[1] to calculate the velocity of the air at a height, by assuming a certain law of variation. Mr. Stevenson supposes the velocity to vary directly as the height; and observing the velocity at some comparatively low level, as for instance at a height of 50 feet, would calculate the velocity at any other required height by simple Rule of Three. To this Mr. Archibald objects that the results so obtained are much greater than the means observed at Berlin; and proposes instead the law that the velocity varies as the fourth root of the height,—a rule which does indeed give results closely approximating to the observations specially referred to, but is not so successful when compared with other observations. For the fact, as it seems to me, is that there is no such constant proportion: we have sometimes an almost perfect calm near the surface of the earth, whilst, far overhead, a furious gale is blowing; and sometimes we have a strong wind near the surface whilst overhead the air has little or no motion: readers of Professor Piazzi Smyth's *Teneriffe* will remember some curious and strongly marked instances of this. Again, we very commonly see by the drift of the clouds, that the wind of the upper strata has a direction different from that of the surface, or even opposite to it: and no formula, simple or complex, can embrace these widely differing cases: there is nothing to be relied on but actual observation.

But with the exceptions of clouds, mountain-peaks and balloons, no observations of upper currents have been attempted before the early days of this last year, when, on the suggestion of Mr. Francis Galton, and at the request of the Meteorological Council, Captain Noble of Elswick made a few experiments which seem to hold out a promise of leading to most interesting results.

A light field piece, firing a 6-lb. shell, was mounted at an angle of 75°, this being the greatest elevation that was considered consistent with safety.

[1] *Nature* (Jan. 11.) Vol. xxvii. p. 243.

By fitting the shells with time fuses of different lengths, it was found that they might be burst at any wished-for height; and they were actually so burst at heights varying from 2,500 ft. to 9,500 ft., the height being calculated pretty exactly by the observed angle of the smoke-cloud at the moment of bursting, and the time-interval from the sight of the cloud to the sound of the explosion. There would be no difficulty in obtaining still greater heights by using a larger gun, though, of course, at an increased expense; but the possibility being once established, it was not thought necessary to prove the extreme limits. Neither, as I understand, have the experiments as yet been carried further, nor any observations of velocity been made: I believe the course of public affairs during the summer and autumn has prevented our guns being used as mere harmless anemometers. Even so, however, we cannot but recognise the great advance in our knowledge of the movements of upper currents which is foreshadowed by this method of causing a small well-defined cloud to be sharply formed under circumstances which permit of its path being followed and measured with the utmost precision.

The subject of wind is so closely connected with that of barometric pressure, that I am led by an easy transition to offer some remarks on certain aspects of that branch of our science. Perhaps no meteorological element is more constantly observed than this: I believe none is less understood. I do not specially refer to the many thousands of simple-minded men and women who look on the barometer as a weather glass, and pin their faith to the absurd legend with which makers will persist in spoiling the faces of their instruments: I refer rather to all meteorologists—men who really have devoted some study to the barometer and its indications.

I fear, for instance, that we are all very much in the dark as to the causes of change in barometric pressure. We may speculate—we may believe; but do we know? For myself, I am in no humour to dogmatise: the conclusions I have arrived at are not those of men whose opinions I am bound to respect. By a reference, on the one hand, to the high barometer in the sweltering and humid climate of the upper valley of the Amazon,—to what Maury and other American writers have spoken of as the barometric anomaly at the foot of the Andes,—or on the other, to the low barometer amidst the ice-fields of high Southern latitudes, I had persuaded myself that the old idea that barometric pressure was merely a question of the weight of the atmospheric column, depending mainly on the temperature, was now happily exploded; but I find Mr. Buchan, in a paper only just published,[1] saying:—"The influence of the land is to lower the pressure in the warmer months, and to increase it in the colder months of the year, just as takes place on a large scale over the continents of the globe during the summer and winter months." I am compelled to dissent from the inference, though I do so not with any idea of now discussing the question, but rather as illustrating the uncertainty of which I have spoken.

[1] "Mean Atmospheric Pressure of the British Islands," in *Journal of the Scottish Meteorological Society* (1882), vol. vi. p. 12.

I would not, of course, be understood as holding that temperature and humidity have nothing to do with the barometric pressure, but rather as believing that the temperature and humidity observed near the earth's surface can seldom be taken as indications of the temperature and humidity of the higher strata, and are not a correct guide to any inference as to the weight of the atmospheric column. But whatever may be the influence of temperature and humidity, I believe that barometric changes are more frequently due to the mechanical condensation or rarefaction of the air. I believe that very frequently a low barometer shows an actual deficit of air, or a high barometer an actual excess; and I am thus led to doubt whether the reduction to sea-level has, in all cases, the meaning which we are accustomed to assign it. For comparatively low altitudes, within the same meteorological region, the barometric differences due to height may, perhaps, be properly enough corrected, and the reduced readings take their place on a synoptic chart, though I think even that is doubtful; but I am utterly at a loss as to the meaning of such a synoptic chart for such a region as the western half of North America, a chart showing a perfect cyclonic or anticyclonic system extending from the Pacific Ocean on the one side to the great prairies on the other, with the isobars drawn as accurately as if the mountains, towering to a height of some 15,000 ft., had no existence.

On such a chart I see a centre of high pressure lying over the central district of the mountains; Denver, Pike's Peak, Salt Lake City, within the isobar of 30·20 ins. I cannot help asking myself what does this pressure of 30·20 ins. mean? It certainly does not mean an accumulation of air, for on the level of this isobar there is no air at all: nothing but rock. But the example, once set, has been contagious; and, by similar reductions, Professor Loomis considers that he traces the passage of centres of low pressure across the Rocky Mountains. That a low pressure may occur on the Pacific coast, and, a few days later, a low pressure be observed in the Mississippi valley, or on the Atlantic coast, is certain enough; but *post hoc* is not necessarily *propter hoc*, and I am not prepared to admit the deduction which Professor Loomis has drawn.

We do not know sufficient about the pressure at high levels to have any confidence in hypothetical isobars; and the motion of clouds, which Mr. Ley has so well described, would seem to show that above a storm-centre of low pressure there may perhaps be a centre of relatively high pressure, or conversely, that above the high pressure in the centre of an anticyclone there may be a relatively low pressure. If this is so, then the low pressure observed at elevated stations ought to be interpreted as an anticyclone, rather than as an imaginary cyclone raging within the solid base of the mountains.

But if this is the case, what becomes of our theory of the reduction of the barometer from great heights to sea-level? or what of our theory for the barometric measurement of heights?

It is customary to believe that whatever else may be uncertain in meteorology, this, at least, is certain, resting on a firm mathematical basis, and

approved by all mathematicians and physicists, from Laplace to the late Clerk Maxwell. Notwithstanding this, I think it is very easy to place too high a value on such reductions and measurements. The meteorologists, geographers and surveyors of the United States have devoted great time and care to the practical investigation of these hypsometrical problems, and have been forced to the conclusion, as stated by Professor Loomis,[1] that "It does not seem possible, however, by any change of these coefficients to modify the Laplace formula so that it may satisfactorily represent the results at all of the preceding stations; or even at a single station for all variations of temperature and pressure. . . . There is no doubt that the formulæ of reduction now employed may be considerably improved; but it does not seem possible that any single formula with constant coefficients should provide for the immense variety of conditions which prevail in the neighbourhood of mountain stations; and we may be compelled for each mountain region to adopt tables founded upon a direct comparison of observations made at stations of different elevations and not very remote from each other."

The fact is that all hypsometrical formulæ, however used, are based on the assumptions that the successive strata of the atmosphere are in statical equilibrium; that atmospheric pressure and atmospheric weight are the same thing; and that it decreases upwards in regular geometric progression. These assumptions, from a meteorologist's point of view, are pure fiction. We know that pressure and weight are two very different things, even though they may be, commonly, in close relation to each other: and we know very certainly, that the atmospheric strata are seldom, if ever, in statical equilibrium; that frequently the curious mixture or alternation of hot and cold strata shows that the first necessities of statical equilibrium have had nothing whatever to do with their arrangement. Many instances of this have been recorded as observed both in balloons and on mountain slopes. I may, however, mention one, of somewhat exceptional nature, which has been described to me, from his own personal experience, by Captain Valentine Johnson, R.N.

In, or about the autumn of 1854, Captain Johnson was the navigating officer of H.M.S. *Antelope*, then off Cape Spartel. He was wakened one night by a feeling of suffocation and intense heat, which gave him at once the idea that the ship was on fire. He bounded out of bed; and, with nothing on but his shirt, which was wet through with perspiration, he rushed on deck. There was no fire; but, as he found, a hot squall had suddenly struck the ship: any exact notes that were taken of it were lost on board H.M.S. *Bombay*, which was burnt in 1864: but the stifling sensation which, in the first instance, awoke Captain Johnson, and which was experienced by every one on board, testifies to the extreme heat: and the fact that it dried his shirt almost instantaneously testifies to the extreme dryness: and yet it was blowing from seaward. That the air had been heated and dried over the

[1] "Contributions to Meteorology;" No. 15, p. 15: from the *American Journal of Science*. Third Series, vol. xxii. 1881.

Sahara, there could be no doubt; yet here it was blowing from the sea towards the African coast.

Such an experience is clearly contrary to any idea of stratified equilibrium, and tells not only of the local disturbance of temperature and humidity, but also—as it seems to me—of disturbance of elastic force and barometric pressure. We know that air will not readily mix with other air which is in a markedly different physical condition, *e.g.* of temperature or humidity. It has this property in common with liquids; such as hot and cold milk in a basin, or the Gulf Stream and the United States Coast Current in the Atlantic Ocean: and I can conceive that, by reason of this property, a mass of air heated to an extreme degree, as over the African Desert, and rendered viscous by this heating; having also its vapour superheated, with an enormous increase to its coefficient of expansion; I can conceive—I say—that such a mass of heated and superheated air may, as one united body, burst through its envelope of cooler air, and by its own elastic force, by its own resilience, bound into the upper regions of the atmosphere—pretty much as, on a small scale, a jack-jumper or a jumping-frog will bound from the nursery table. I can conceive that this air may retain its cohesion and, to some extent, its elastic force, thus differing greatly, in humidity, temperature, specific gravity and barometric pressure, from all around it; and being carried to some distant locality by the upper current into which it has intruded, may be rolled along, as mud is rolled along by a current of water; and, when the force of that current dies out, may settle by reason of its specific weight, just as the mud of the Thames settles between the North Foreland and Harwich, or as the mud of the Mississippi has formed the alluvial flats to the southward of New Orleans. I do not say that this is what does happen, but that I can conceive it happening: there are perhaps other ways in which a phenomenon, such as I have referred to, may be explained; but whatever they are, they must depend, to some extent at least, on motion, on some force acting kinetically.

And whatever may be the exact cause of such phenomena, it is quite certain that they occur; not perhaps very frequently in a manner so marked as the one I have described and tried to explain; but frequently enough, in all probability, in a manner less marked, less obvious, but therefore more subtle and more dangerous. For if an observer on top of a mountain, or in a balloon, finds himself in the midst of a blast as from the mouth of a furnace, the observations are, on the very face of them, suspicious: but hundreds and thousands of cases may occur in which air from the surface of the earth is, in some way or other—no matter how—lifted bodily into the upper regions; and without showing anything very extraordinary in its temperature or dryness, may still have an elastic force peculiarly its own, or at least very different from that which, according to a mere static theory of equilibrium, belongs to the level to which it has been raised.

Now, of all the various ways in which air may possibly be lifted, the most common is probably that arising from the horizontal thrust of wind against a mountain slope, which may, and must, and does carry to the top a great deal of air which, if left to itself, would stay at the bottom. The rain caused

by the ascent of vapour-bearing air is a familiar instance of this: it is not only that such air is driven to the top of the slope, but that it has a distinct ascensional movement communicated to it, so that it continues to rise after it has cleared the summit. The familiar fact that most rain falls not on the weather, but on the lee side of hills of moderate height, is a proof of this. The celebrated Stye-Head gauge is some way down the slope, Seathwaite is at the foot of it, and both are on the North-east side. On the South-west side of the ridge, which is Wastdale, the rainfall is nothing remarkable.

It is then on mountain slopes and mountain summits, more especially, perhaps, at moderate altitudes, that we are most likely to meet with such stray masses of air: it is just at those places for which we want the reductions of the barometer with the greatest accuracy that this element of uncertainty is most frequent and most probable.

But secondly, since for correct reduction or for the calculation of altitude, it is necessary to have observations at the base as well as at the summit or upper station, the question must arise as to the exact value of the lower observations. The barometric pressures on opposite sides of a hill, a mountain, or a mountain range, are seldom the same; owing, perhaps, to the mechanical condensation of air on the weather side, or to its rarefaction on the lee side; or, perhaps, owing to the air on one side, by reason of the contour of the surface, not having so ready an escape, if from some physical cause its pressure is in excess, or not finding so ready a supply, if in defect. Most commonly the lower observation can only be made on one side; and that one is determined by convenience, not by meteorological considerations. If a great many observations are taken at times extending over a considerable period, and under all possible conditions of weather, the mean may, perhaps, give results that are approximately true. It is in this way that the very elaborate hypsometric observations of the United States surveyors have been taken, and their results are no doubt fairly correct: but one set of observations taken, as travellers must take them, when opportunity offers, can give nothing better than a rough estimate, except by some lucky accident. And when, as is very frequently the case, the synchronous observations cannot be taken at all, and the height above sea-level is computed by reference to some estimated pressure, or to some known mean hundreds of miles away, there is absolutely no guarantee whatever that the results so obtained have even a resemblance to the truth.

The observations made by Mr. Wallace at the mouth of the Rio Negro,[1] which gave that station at a considerably lower level than Para, afford one instance of this. The observations by Erman as he drew nigh to the Sea of Ochotzk, which led him to suppose himself some 400 ft. higher than he really was,[2] afford another. These are historical instances, the first indica-

[1] *Travels on the Amazon and Rio Negro*, p. 411. See also paper on "The Andes and Amazon," by Professor Orton, in *Silliman's American Journal of Science*, 2nd Series, Vol. xlvi. p. 203.

[2] *Reise um die Erde*, Vol. ii. p. 425.

tions of the barometric peculiarities of these regions; but it is impossible to say that similar peculiarities, whether permanent or accidental, may not be met with to the confusion of the traveller or the meteorologist.

Such considerations compel me to mistrust a great many of the lines shown on isobaric charts. When it is determined to make such a chart, with or without sufficient data, the isobar has to go in: there is always a temptation to lead it or to bend it in accordance with pre-conceived notions. Where the height of a tract of land has not been determined by levelling, it may be calculated by the height of the barometer referred to some assumed *datum;* and, if I am not mistaken, the same observations, especially when very few and uncertain, may at once determine the height, the correction for height, and the corrected reading for the isobar. As to isobars which are drawn freely enough traversing wide districts that never saw a barometer, they are, of course, simply works of imagination. Such, for instance, are the isobars across the Sahara or equatorial Africa, the Himalayas, the Rocky Mountains, a great part of South America, or the glacier-clad heights of Greenland. They stand to meteorology in the same relation as the weather predictions in *Murphy's Almanac*, and to geography in the relation of the exact details in *Gulliver's Travels*.

Another and very important phase of the problem is the vexed question whether the axes of cyclones are vertical or not. On this there is a very wide diversity of opinion. An idea that they lean towards the equator, *i.e.*, towards the South in the Northern hemisphere and towards the North in the Southern, has been, during the past year, again brought forward by Mr. J. A. Westwood Oliver,[1] who thinks that, by reason of such an inclination, the Northern (or polar) side of our cyclones is tilted up into the higher regions of the atmosphere, and so lost at the surface. The explanation which has been given of this supposed tilting is that a cyclone, formed in lower latitudes, has its axis nearly perpendicular to the axis of the earth, and that, as it travels into higher latitudes, its axis, by the principle of the gyroscope, moves parallel to itself, remaining perpendicular to the earth's axis, but becoming sharply inclined to the earth's surface. To such a theory there are many objections, the most apparent and perhaps the most conclusive of which is the fact that the cyclones of these latitudes do not, as a rule, if ever, come from low latitudes.

My impression is that this supposed leaning to the Southward rests on imperfect and insufficient observation; and that the apparent preponderance of the Southern half of our cyclones is due to the fact (as Mr. Archibald has clearly stated)[2] "that our cyclones are for the most part secondaries, moving within the periphery of a large, nearly permanent cyclone, whose centre generally lies not far from Iceland, and thus those winds and gradients predominate, which would tend to occur in that part of the large cyclone where we happen to be situated." I accept this view now as virtually the same as the one which I have long maintained; but it has, on the other hand, been

[1] *Nature*, Vol. xxvi. p. 222. [2] *Ibid.*

formerly objected to me, that such a theory of the advance of cyclones would ignore the Northern half, which, I was told, is just as strongly marked as the Southern. For my own part, I am quite convinced that it is not: but there is, it seems, room for a difference of opinion; and that room I should be very glad to see choked up.

In opposition, however, to the Southerly (or equatorial) inclination of a cyclone's axis, Mr. Ley thinks that he has detected a certain backward inclination, as manifested in the retardation of barometric minima at the higher observing stations in the United States: and others again, with whom is Mr. Ferrel, think that the inclination, if any, is rather forwards than backwards. But whichever of these is correct; whether the axis of a cyclone inclines forwards, or backwards, or sideways, there is evidently, amongst our most capable men, a widespread belief, supported by careful observation, that the time of a barometric minimum at an upper level does not coincide with that of a barometric minimum at the earth's surface. The admission of this seems to me a fatal blow to the system of barometric reduction, as practised in our own and in all other countries. The consideration is a very serious one; but it points to one definite issue,—the necessity of reform.

I think we have been working long enough on the old lines that were traced out a hundred years or more ago, when it was pardonable to believe that the barometer did—as its name signifies—measure the weight of the atmospheric column. We know now that it does not: that what it measures is the elastic force of the air immediately adjacent to its cistern; and though this elastic force is a function of the weight of the column, it is far from being identical with it. But though we know this, we have not attempted to utilise the knowledge; and writer after writer goes on repeating the formula calculated on purely static data. This is not merely my opinion. Professor Loomis, one of the most careful and painstaking of modern meteorologists, has expressed himself in language nearly as strong. He has said:—"The Laplace formula assumes that the atmosphere has attained a condition of equilibrium, and in such a case it gives the reduction to sea-level with tolerable accuracy. The average of a long series of observations represents approximately such a condition of equilibrium; but in the daily observations this equilibrium is very much disturbed." And again:—"If the formulæ of reduction to sea-level hitherto employed are admitted to be unsatisfactory for great elevations, it does not seem safe to conclude that they are correct for small elevations. For elevations less than 1,000 ft. the error of reduction is less palpable than for an elevation of 6,000 ft.; but it is probable that the error is only proportionally diminished."

How far this error affects the daily charts issued by our Meteorological Office, and the forecasts which are based on them, it is impossible to say. Considering the great difficulties, not only of meteorology but of finance, which the office has to struggle against, the daily forecasts are surprisingly good: but they do go wrong sometimes; and whilst I know that the want of funds is very largely the cause, it is possible that an erroneous reduction of the barometer, an error in drawing the isobars, may occasionally have some-

thing to do with it. In any case it is a thing that ought to be inquired into; and the sooner, the better. It is this which leads me to take perhaps an exaggerated view of the high level observations, such as Mr. Wragge has been making on the summit of Ben Nevis, concerning which Mr. Buchan writes that considering the remarkable differences from the normals shown in the vertical distribution of pressure, temperature and humidity, between the top of Ben Nevis and the sea-level, in reference to the weather that followed, the observations made at this station will contribute invaluable aid in framing weather forecasts for the British Islands, and especially forecasts of rainy or dry weather. It is pleasant to believe in the probability of the Scottish Society being able to establish a permanent observatory on that summit: it would be still more pleasant if there was even a possibility of observatories, similar to that proposed, being established on the tops of half a dozen of our highest hills in different parts of the country. We have in London and in England plenty of men who might found such, and not know that they were out of pocket by doing so; the establishment and endowment of a mountain observatory would not cost more than a Louis XV. cabinet, or a Marie-Antoinette writing table; it would be more useful, and the fame of it would go farther. The time may come, and the fashion may change; but for the present we must content ourselves with small beginnings and slow advances, trusting to the gradual achievement of progress and remembering that—

> "One brick and then another, and the highest wall is made:
> One flake and then another, and the deepest snow is laid."

REPORT OF THE COUNCIL

FOR THE YEAR 1882.

It has been objected to Meteorology as a science that too many observations are taken, and that too little time and attention are bestowed in discussing and comparing them when made. But the Council are of opinion that even now the observations recorded for the Society are by no means too numerous, and they have, indeed, somewhat increased the number of climatological stations, in the hope before long of instituting a careful comparison of the observations kept by their Fellows and published in the *Meteorological Record*. The time, however, during which most of the stations have been conducted is, as yet, too short for any satisfactory comparison to be made.

In the last Annual Report reference was made to a proposal for supplementing the ordinary observations by a series of well-conducted experiments destined to throw light on such questions as the vertical decrement of temperature, the movements of vapour, the height of cloud strata, the variation in the velocity of the wind at different elevations, &c. As a step in this

direction it was decided that simultaneous observations of temperature should be taken at the summit and base of Boston Church Tower. This has been accomplished by means of an electrical thermometer, which was most kindly placed at the disposal of the Council by Mr. (now Sir C. W.) Siemens, D.C.L., F.R.S.

Dr. Siemens' electrical thermometer is an instrument, the construction of which is based upon the fact that the resistance opposed by a copper wire to the passage of a current of electricity along it, increases when heated according to a definite law. The thermometer may be described as follows :— Insulated wire is wound round a cylindrical piece of wood, and enclosed in a metal casing, one end is joined to a thicker insulated wire and the other to a similar one soldered to it, the three parallel wires being formed into a cable and connected at their opposite ends, the one with a battery, and the other two with a galvanometer. A current of electricity then proceeding from a battery to the coil becomes divided at the base of the coil, which is placed at the spot whose temperature it is desired to determine, and part of the current returns through the coil, whilst the other part returns through the uncoiled wire to a resistance coil attached to a differential galvanometer at the observer's station. To read the temperature at the top of the tower all the observer has to do is to send a current of electricity from the battery into the cable, and then watching the galvanometer to vary the moveable resistance until the current passing through it is equal to that passing through the thermometer coil as indicated by the galvanometer. Finally, reading off on a scale the amount of resistance he has just put in circuit by means of a suitable table, he is able to find the temperature he desires to know.

In the early part of this year the electrical thermometer was tested at Kew and found to work very satisfactorily, though it was rather sluggish. Mr. Marriott went to Boston to superintend fixing the instruments, of which he gave the following account :—

"On February 27th, I went to Boston to superintend the fixing of the instruments. The electrical thermometer has been placed in a wall screen on a pinnacle on the north of the tower facing West-south-west. A board has been fastened on the south side of the screen to protect it from the sun's rays. An ordinary thermometer has also been mounted in the screen, along with the electrical one, to be read occasionally as a check upon the other. The cable has been brought down the inside of the tower, then through the belfry, and so to the base of the tower inside the church. A strong box or cupboard, with a solid top for a table, has been prepared and placed in a recess on the south side of the base of the tower. The galvanometer has been placed on the top of the table and the battery on a shelf inside the cupboard. The cable is brought through this cupboard at the bottom, and passed on to the binding screws on the table in connection with the galvanometer. In the South-east angle of the tower, above the roof of the belfry a Stevenson screen has been fixed, containing dry, wet, maximum and minimum thermometers. As Mr. Hackford's (the observer's) garden is very much confined, I obtained the per-

mission of the Vicar to fix the Stevenson screen in the churchyard, where there is a good exposure. I accordingly telegraphed to Mr. Casella to send down another set of thermometers, as it seemed undesirable to interfere with the instruments in Mr. Hackford's garden. The heights of the different screens are:—(1) on the top of the tower, 270 feet; (2) on the belfry, 170 feet; and (3) in the churchyard, 4 feet above the ground. All the thermometers will be read daily at 9 a.m.; and readings of the electrical thermometer at the top of the tower and of the dry bulb in the churchyard will be taken several times during the day. I was greatly assisted by the ready co-operation and help of Mr. Hackford, the verger, who has entered fully into the undertaking; and I think that the Society is to be congratulated in having so careful and competent an observer to take the readings of the instruments. I cannot conclude without also referring to the consent and support given to the whole of the proceedings by Canon Blenkin, the Vicar, the Churchwardens, Dr. Adam, and other gentlemen."

In addition to the ordinary observations at Boston Church, it has been arranged with Mr. Hackford that hourly observations shall be made from 9 p.m. on Saturdays to 9 p.m. on Sundays during the winter, as the night observations can be taken by a man who is in attendance at the church from 8 p.m. on Saturday to 8 a.m. on Sunday to regulate the heating apparatus.

In furtherance of the objects mentioned in last year's report, the Council communicated with several societies, suggesting the appointment of a Conference "to investigate the methods at present in use for measuring the force and velocity of the wind, and to endeavour to settle the several points now in dispute;" but the suggestion, though well supported, did not meet with general acceptance, and it was deemed unadvisable to proceed further in the matter at present.

In response to an application from this Council, a letter has been received from the Secretary to the Meteorological Council, to the effect that the Meteorological Office purposes to discuss the weather of the North Atlantic Ocean for the thirteen months beginning August 1st, 1882. The inquiry may be expected greatly to increase our knowledge of general meteorology, and the Council look forward to the publication of the results with much satisfaction.

The systematic inspection of stations has been carried on as usual. Nearly all those in the southern half of England have been visited by the Assistant-Secretary. On the whole they were found in a very satisfactory condition. The observers appear to take an interest in the records, and endeavour to make them as accurate as possible. It was, however, found that the Stevenson screen was not used at all the stations; several screens, although nominally of this pattern, were larger than usual, and others had single louvres. A diversity of method in fixing the instruments in the screen was also noticed, in some cases the thermometers were all placed against the back of the screen, while in others the maximum and minimum thermometers were in front of the dry and wet bulbs. It was therefore recommended that the kind of screen used at all the stations should be strictly the same, that the thermometers should be mounted in the same way, and that the

screen should be painted white in every year in the month of May. However, it must be said that, with two exceptions, the departures from the Stevenson screen were comparatively slight as regards their influence on the observations.

With respect to the screen itself, the Council have appointed a Committee to report on the precise size for the screen and the position of the instruments in it; and they hope, when their recommendations have been carried out, that complete uniformity in these points will be obtained at all the stations belonging to the Society.

In May last a circular was sent to all the observers, containing the following suggestions, as calculated to promote greater accuracy in the returns, and to lighten the duties of the office staff, which is much overweighted by work. The circular has produced good results, and the Council trust that this reminder will aid in obtaining the objects they had in view.

1. The muslin and conducting thread of the wet-bulb thermometer should be changed at least once a month.
2. The tops of the tubes of the minimum thermometers should be frequently examined, to see whether any spirit has evaporated from the column.
3. The thermometer screen should be painted white during May of *each* year.
4. In the "Remarks" column the special features of the day should be noted, together with the different phenomena and the time of their occurrence.
5. All the entries on the Returns should be checked against those in the original observation book.
6. All the readings should be corrected and reduced.
7. The sums and means should be taken of all the columns where required. Great care should be taken that the addition is correct; it is, therefore, desirable that the columns be added twice, first *upwards* and then *downwards*.

[*Especial attention is called to Nos.* 6 *and* 7.]

8. The Return should be forwarded to the Society *not later* than the 10th of the month following that to which it belongs.

The Council are determined that the Society's *Meteorological Record* shall be a publication of the highest attainable standard of accuracy; and in making the annual revision of the list of Stations, they will be guided as to the printing of the observations by the amount of attention paid to their wishes and suggestions in these matters.

An arrangement has been made with the Rector and Churchwardens of St. Luke's, Old Street, E.C., to place and maintain a Stevenson screen and thermometers in the churchyard attached to the church. This is a valuable acquisition. Hitherto there has not been a satisfactory station in the centre of London, the stations at Regent's Park and Greenwich being too exposed to give more than an approximation to the range of temperature, or even to the mean temperature, of the Metropolis. In addition to this six new stations have been accepted, namely:—Bolton, Boston, Cramlington, Hastings, Margate, and Ramsgate (The Vale); and four stations have been discontinued, namely:—Blackburn, Loughborough, Mansfield, and Ramsgate (St. Augustine's).

In March an exhibition of anemometers was held in the Library of the Institution of Civil Engineers, by the permission of the Council of that Society. It was extremely successful, and was kept open for three weeks, while two papers bearing on the instruments exhibited were read and discussed by

that body. During this time about 1,000 persons visited the exhibition. The cost to this Society was comparatively small; no expenses were incurred except for such fittings as were necessary to display the instruments. The Committee for carrying out the arrangements and for procuring the loan of the anemometers were—the President, Mr. Ellis, Mr. Field, Mr. Strachan, Mr. Symons, and Mr. Whipple.

The Council during the year have had the assistance of the following Committees:—

EDITING COMMITTEE:—Mr. Eaton, Mr. Scott and Mr. Whipple.

GENERAL PURPOSES COMMITTEE:—The President, Secretaries, Foreign Secretary, Treasurer, Mr. Ellis, Mr. Latham and Mr. Lecky.

DECREASE IN WATER SUPPLY COMMITTEE.—The President, Mr. Field, Mr. Latham and Mr. Symons.

EXPERIMENTAL RESEARCH COMMITTEE:—The President, Prof. Archibald, Mr. Eaton, Dr. Gilbert, Hon. F. A. R. Russell, Mr. Scott and Mr. Symons.

As the Instructions for the Observations of Phenological Phenomena had gone out of print, the Council appointed a Committee consisting of the President, Dr. Gilbert, the Rev. T. A. Preston, Miss E. A. Ormerod, and Messrs. Dymond, Eaton, and Symons, to consult with the other Societies who joined in preparing the original Instructions as to the desirability of continuing or modifying the observations and the publication of them by the Society. The Committee, in a provisonal Report, recommended that the observations should be continued, and took steps for the revision of the Instructions.

The Council have obtained the complete series of private MS. Meteorological Journals for the years 1811-1856, kept by the late Mr. John Henry Belville, of the Royal Observatory, Greenwich. These have been intrusted to one of the members of the Council for the reduction of the thermometrical observations.

The amount spent in the purchase of MSS. and books and in book-binding during the year was £25, and a further outlay is required for binding books and pamphlets. Both the printed and MS. catalogues of the Library have been lent to Mr. Symons to incorporate with the General Catalogue of Meteorological Books in course of preparation by him for the U.S. Signal Service.

Among the Papers which have been contributed to the Society, special notice may be directed to that on Anemometry and Anemometers, by Mr. Laughton, the President, wherein he gives an account of the different patterns and forms of anemometers, and the names of all the inventors of such apparatus that he has met with, together with the date and class of instrument; and to Mr. Abercromby's paper "On certain Types of British Weather," which seems calculated to promote more successful forecasting. The other Papers published in the Journal of the year are, in the opinion of the Council, creditable additions to the Science, particularly Mr. Preston's Report on the Phenological Phenomena, a work of great labour. The following is a list of the Papers read during the year, with the names of the authors:—

R. H. CURTIS, F.M.S., and C. E. BURTON, B.A., F.R.A.S.—"Notes on experiments of the distribution of pressure upon flat surfaces perpendicularly exposed to the wind."

Commander R. A. EDWIN, R.N., F.M.S.—"The Principle of New Zealand Weather Forecasts."

H. S. WALLIS, F.M.S.—"The High Atmospheric Pressure in the middle of January, 1882."

J. K. LAUGHTON, M.A., F.R.G.S., President.—"Historical Sketch of Anemometry and Anemometers."

G. M. WHIPPLE, B.Sc., F.R.A.S., F.M.S., and T. W. BAKER, F.M.S.—"Barometric Gradients in connection with Wind Velocity and Direction at the Kew Observatory."

G. DINES, F.M.S.—"On difference of Temperature with Elevation."

Hon. R. ABERCROMBY, F.M.S.—"On the Diurnal Variation of Wind and Weather in relation to Isobaric lines."

W. F. STANLEY, F.M.S.—"The Mechanical conditions of Storms, Hurricanes, and Cyclones."

A. ROSS.—"Weather Statistics for Sydney, 1841-1846, and for Melbourne, 1848-1866."

Rev. F. W. STOW, M.A., F.M.S.—"A new metal Screen for Thermometers."

D. GILL, LL.D., F.R.A.S.—"On the effect of different kinds of Thermometer Screens and of different exposures in estimating the Diurnal Range of Temperature at the Royal Observatory, Cape of Good Hope."

C. S. HUDSON.—"Account of a Cyclone in the Mozambique Channel, January 14th-19th, 1880."

R. H. TWIGG, M.Inst.C.E., F.M.S.—"Rainfall of Frere Town, Mombassa, East Coast of Africa, 1875-1881."

Hon. R. ABERCROMBY, F.M.S.—"On Certain Types of British Weather."

Prof. E. D. ARCHIBALD, M.A., F.M.S.—"On the use of Kites for Meteorological Observations."

C. N. PEARSON, F.M.S.—"The Meteorology of Mozufferpore, Tirhoot, 1881."

Hon. R. ABERCROMBY, F.M.S., and W. MARRIOTT, F.M.S.—"Popular Weather Prognostics."

Rev. T. A. PRESTON, M.A., F.M.S.—"Report on the Phenological Observations for the year 1882."

Rev. H. H. SLATER.—"Report on the Ornithological Observations for the year 1882."

The exchange list published in the *Quarterly Journal* for April, 1882, indicates that the Society's publications are widely distributed. The *Meteorological Record* has been issued regularly, and certainly surpasses any collection of meteorological statistics of a similar nature which has appeared in this country.

The Staff remains the same as last year, and has ably performed all the requisite work of the Society.

The financial position of the Society is good: but the cost of the Staff; of printing the Journal and Record; and of providing the numerous illustrations in the Journal become greater every year. There has also been a large outlay for installing the apparatus at Boston Church Tower. The number of Life Compositions was small, only £71 having been received from this source, against £132 in 1881. The following summary for the last four years shows the amounts received from subscriptions, entrance fees, and life compositions:—

	1879.	1880.	1881.	1882.
Subscriptions ...	£357 14 0	£355 2 0	£399 6 6	£491 5 0
Entrance-Fees ...	80 4 0	47 0 0	77 8 0	44 2 0
Life Compositions	144 0 0	144 0 0	132 0 0	71 0 0
Totals.....	£581 18 0	£546 2 0	£608 14 6	£606 7 0

The number of Life Fellows on the roll of the Society is 117, being an increase of six in the year; and of Ordinary Fellows 436, against 426 last year; and there are eighteen Honorary Members; thus making a total of 571. The annexed tabular statement indicates the changes in the course of the year.

Fellows.	Life.	Ordinary.	Honorary.	Total.
1881, December 31 ...	111	426	18	555
Since elected	+ 4	+41	+ 2	+47
Since compounded.....	+ 2	− 2	...	0
Deceased	...	− 5	− 2	− 7
Retired	...	−14	...	−14
Defaulters	...	−11	...	−11
Reinstated	...	+ 1	...	+ 1
1882, December 31 ...	117	436	18	571

The Society has to deplore the loss, by death, of two of its Honorary Members, Senor Antonio Aguilar, elected June 16th, 1880, and Professor E. Plantamour, elected June 17th, 1874; of one of its Past-Presidents, Charles Vincent Walker, F.R.S., F.R.A.S., elected June 4th, 1850; and of four other Fellows, Samuel Richard Bosanquet, elected November 16th, 1881; Thomas Buckland, elected December 17th, 1879; Henry Dodgson, M.D., F.R.A.S., elected April 20th, 1864; Rear Admiral Matthew Stainton Nolloth, F.R.G.S., elected January 20th, 1875.

Finally, in resigning the trust committed to their hands, the Council confidently appeal to the record of the work of the Meteorological Society for the past year as work done well and carefully with very moderate means, and which, though perhaps not elucidating any prominent feature for the present, is yet destined to promote the advancement of Meteorology and to bear fruit in a not distant future.

APPEN-

ABSTRACT OF RECEIPTS AND EXPENDITURE

Receipts.

	£	s.	d.	£	s.	d.
Balance from 1881				127	6	6
Dividend on £800 M. S. and L. R. 4½ Debenture Stock	35	5	0			
Do. £386 18s. 0d. New 3 per Cents.	11	6	6			
				46	11	6
Subscriptions for 1879	1	0	0			
Do. 1880	20	10	0			
Do. 1881	60	2	0			
Do. 1882	395	12	0			
Do. 1883	14	1	0			
Entrance Fees	44	2	0			
Life Compositions	71	0	0			
				606	7	0
Meteorological Office:—						
Copies of Monthly Returns	100	0	0			
Do. Annual „	2	10	0			
Do. Weekly „	5	2	7			
Grant towards Inspection Expenses	25	0	0			
				132	12	7
Sale of Publications				35	1	6
Part cost of printing Paper on Meteorology of Cannes				2	10	0
				£950	9	1

DIX I.

FOR THE YEAR ENDING DECEMBER 31ST, 1882.

EXPENDITURE.

	£	s.	d.	£	s.	d.
Journal, &c.:—						
Printing Nos. 41-44.	134	8	6			
Illustrations	34	18	6			
Authors' Copies	14	3	0			
Meteorological Record.	51	13	9			
Registrar General's Reports	8	8	0			
				243	11	9
Printing, &c.:—						
General Printing	20	13	3			
List of Fellows	13	0	0			
Stationery	11	19	6			
Books and Bookbinding	25	9	0			
				71	1	9
Salaries:—						
Assistant Secretary	155	0	0			
Computers	101	8	0			
Overtime	12	0	0			
				268	8	0
Office Expenses:—						
Rent and Housekeeper	48	6	6			
Furniture, Coals and Insurance	4	1	9			
Postage	39	11	9			
Refreshments at Meetings	12	9	7			
Exhibition of Anemometers	5	10	0			
Parcels, Advertisements and Petty Expenses	7	11	1			
				117	10	8
Observations:—						
Inspection of Stations	53	18	0			
Boston Temperature Experiments	18	5	5			
Observer at Seathwaite	2	2	0			
Instruments	2	0	0			
				76	5	5
				776	17	7
Balance:—						
At Bank of England	156	19	2			
In hands of the Assistant-Secretary	16	12	4			
				173	11	6
				£950	9	1

Examined and compared with the vouchers and found correct,

J. S. HARDING,
H. SOWERBY WALLIS, } *Auditors.*

January 8th, 1883.

APPENDIX I.—*Continued.*

ABSTRACT OF ASSETS AND LIABILITIES ON JANUARY 1ST, 1883.

LIABILITIES.

	£	s.	d.
To Subscriptions for 1883 paid in advance	14	1	0
,, Excess* of Assets over Liabilities	1707	6	4
	£1721	7	4

* This excess is exclusive of the value of the Library and Stock of Publications.

ASSETS.

	£	s.	d.	£	s.	d.
By Society's Money invested in New 3 per Cents., £386 18s. at 101¼	391	14	8			
,, Society's Money invested in M. S. and L. R. 4½ Debenture Stock, £800 at 122.....	976	0	0			
				1367	14	8
,, Subscriptions unpaid, estimated at.....	40	0	0			
,, Entrance Fees unpaid	8	0	0			
,, Dividend on £800 M. S. and L. R. 4½ Debenture Stock	17	9	2			
,, Meteorological Office—Weekly Returns 1882	4	12	0			
				70	1	2
,, Furniture, Fittings, &c.....	40	0	0			
,, Instruments	70	0	0			
				110	0	0
,, Cash in hands of Bank of England.....	156	19	2			
,, Do. the Assistant Secretary	16	12	4			
				173	11	6
				£1721	7	4

J. S. HARDING,
H. SOWERBY WALLIS, } *Auditors.*
WILLIAM MARRIOTT, *Assistant Secretary.*

January 8th, 1883.

APPENDIX II.

REPORT OF THE ASSISTANT-SECRETARY ON THE INSPECTION OF THE STATIONS DURING 1882.

ASHBURTON, *July 29th.*—This station, at the house called "Druid," is situated on the slope of a hill overlooking Ashburton, 1½ mile distant South-east. The thermometer screen, on the lawn in front of the house, is well exposed from the North-east through South to North-west, but is sheltered by the house, trees and hill between the North-west and North-east. The rain-gauge is in a field exposed to all quarters except from the North-west to North-east, where the trees, &c., subtend an angle of 30°. The ground slopes to the South-east. The hill behind on the North-west rises to the height of 800 ft. above sea-level, and subsequently reaches 1,200 ft. The soil is clay-slate (Devonian).—*Observer*, F. AMERY, J.P.

ASPLEY GUISE, *September 28th.*—All the instruments were in good order. Since the last inspection earth thermometers have been established at the following depths:—3 ins., 6 ins., 1 ft., 2 ft. and 4 ft. A sunshine recorder has also been established. The same screen is still used; but the thermometers are better arranged, the dry and wet bulbs being near the middle of the screen, and the maximum and minimum in front of them.—*Observer*, E. E. DYMOND, J.P., F.M.S.

BABBACOMBE, *July 31st.*—This station was in all respects in a satisfactory condition. The observations of the temperature of the sea have been discontinued since May.—*Observer*, E. E. GLYDE, F.M.S.

BEDDINGTON, *August 11th.*—The instruments are over a grass plot in the kitchen garden, only small trees being in the immediate neighbourhood. The ground in the neighbourhood is level. The soil is gravel.—*Observer*, S. ROSTRON, F.M.S.

BOURNEMOUTH, *August 17th.*—Both the observer and the deputy were away at the time of my visit. The screen had a board placed at the back to keep off the sun. This, however, has since been removed. The screen needed fresh painting. The covering of the wet-bulb thermometer appeared not to have been changed for some time. Grass should be laid down round the screen.—*Observer*, Admiral Sir B. J. SULIVAN, K.C.B., F.M.S.

BRAMPFORD SPEKE, *July 26th.*—This station is 4½ miles North of Exeter on the river Exe. The thermometers are on a wall screen fixed to the vegetable garden wall with a North aspect; the wall is about 10 ft. high, and is whitewashed. There are several fruit trees in the immediate vicinity. The grass minimum thermometer is placed on a small patch of grass in the vegetable garden. All the thermometers were in a satisfactory condition, except the grass minimum thermometer, which had 6° of spirit at the top of the tube. There are three rain-gauges on the lawn in front of the house; (1) an ordinary 5-in.; (2) a 5-in. Snowdon; and (3) a home-made 8-in., 3 inches above the ground. The exposure is good, except on the North, where a tree 13 ft. off rises to a considerable height. The soil is gravel.—*Observer*, W. H. GAMLEN.

BRIDGETOWN, TOTNES, *July 29th.*—Everything was in a satisfactory and clean condition. On comparing the thermometers it was found that the zero of the duplicate minimum had gone down 0°·3. The grass minimum thermometer had 1° of spirit at the top of the tube.—*Observer*, T. H. EDMONDS, F.M.S.

BUDE, *July 20th.*—The thermometers were in good order, except the minimum thermometer, which had an error of −0°·3. The position of the thermometer screen is not satisfactory.—*Observer*, J. ARTHUR.

CHELTENHAM, *July 18th.*—The reading of the minimum thermometer was 0°·4 lower than the certified correction. All the other instruments were in good order. A Robinson anemometer has recently been placed on the top of the house, its indications being read off by a telescope from the garden. In January 1881 the barometer suddenly got out of order during the occurrence of a very low pressure. The instrument was subsequently repaired, and is now in good order.—*Observer*, R. TYRER, B.A., F.M.S.

CRANLEIGH, *September 27th.*—In January 1881 the instruments were removed to the new site mentioned in the last report. At present the exposure is good, but in the course of time it will become confined, owing to the planting and growth of fruit trees.—*Observer*, J. BRYAN.

CROMER, *September 5th.*—The same stand was in use as at the last inspection; it had received a coat of white paint. (As reliable observations could not be obtained in this stand, the Council have subsequently sent down a Stevenson screen, so that from January 1st, 1883, the readings may be comparable with those of other stations.) The rain-gauge has been moved to the site selected at the last inspection, and is better exposed than formerly.—*Observer*, J. COOPER, F.R.C.S.

CROYDON, *August 11th.*—Everything was in a satisfactory condition, and the instruments were in good order. A Casella self-recording rain-gauge has recently been added to the equipment of this station.—*Observer*, E. MAWLEY, F.M.S.

CULLOMPTON, *July 19th.*—The instruments have been moved a little further up the garden since the last inspection. The observer was requested to lay down some grass round the screen, and to move the rain-gauge further off, as it was somewhat sheltered by the screen on the North-west. All the thermometers were in good order, except the minimum, which read 0°·3 too low. The sunshine recorder is mounted on the top of an iron gas lamp post, and has a glass cover over it. An earth thermometer, 1 ft. below the surface, has been added.—*Observer*, T. TURNER, J.P., F.M.S.

DOWNSIDE, *July 17th.*—Both the regular observer and his deputy were away for the holidays. The steward was in charge as deputy-observer, but he did not seem very efficient. The grass minimum thermometer had 1°·5 of spirit at the top of the tube. The solar maximum thermometer had been broken a few weeks previously. The screen is only mounted on a single post, and is rather unsteady. I suggested that it should be stayed.—*Observer*, Rev. T. L. ALMOND, O.S.B., F.M.S.

FALMOUTH, *July 22nd.*—The thermometer screen is placed in a garden,

on ground sloping from North to South. The garden is 51 ft. long and 22 ft. wide, and is enclosed by walls 4 ft. high on three sides, and by the house on the South. Florence Terrace is nearly on the top of the hill overlooking the sea. The exposure is fairly open, but somewhat confined. The thermometer screen is a home-made one, 20 ins. square inside, and 2 ft. outside measurement, and has a pyramidal roof. The rain-gauge is in a garden on the other side of the road, close beside the Beckley self-recording rain-gauge belonging to the Falmouth Observatory. The exposure is fairly open. It was proposed shortly to move the gauge a few feet further from the Beckley gauge, and to reduce the height from 2 ft. to 1 ft. above the ground. The observations had hitherto been taken at 9 a.m. Greenwich time; the observer, however, undertook to make them in future at 9 a.m. local time. In July 1883 Mr. Fox will remove to a new house, where there will be much more ground for exposing the thermometers, and also for a rain-gauge. The sub-soil is slate and quartz.—*Observer*, W. L. Fox, F.M.S.

HARESTOCK, *August 22nd.*—Everything at this station was in good order. Col. Knight has duplicates of most instruments, as well as an open screen. Since the last inspection a sunshine recorder and earth thermometers at 1 ft. and 2 ft. below the surface have been added to the equipment.—*Observer*, Lieut.-Col. H. S. KNIGHT, F.M.S.

HASTINGS, *September 26th.*—The instruments are in the garden of the Infirmary, immediately opposite the Pier, in a good central situation. The thermometer screen is a double one, the inner being a zinc-louvred screen, and the outer a screen boarded on three sides and at the top, with a louvred door on the North. This screen was devised by Mr. A. E. Murray, and presented by him to the Infirmary. The reading of the maximum thermometer was 0°·5 too low.—*Observer*, J. PEACH.

HELSTON, *July 22nd.*—The observer was away from home; and as the Stevenson screen was locked, the thermometers could not be examined. The screen is, however, very well exposed, and also the rain-gauge, the latter being in an open field with no object subtending an angle of more than 10° in altitude. The field slopes from North to South, and the station is on the Northern slope, and above the town.—*Observer*, J. GILL.

HILLINGTON, *September 6th.*—The thermometer screen has had some louvres added since the last inspection; it is, however, only single-louvred. The rain-gauge is in its former position, but is occasionally moved.—*Observer*, Rev. H. FFOLKES, M.A., F.M.S.

ILFRACOMBE, *July 20th.*—All the instruments were in a satisfactory condition, and were in the same position as at the last inspection. The returns since January 1881 have been regularly forwarded direct to the Society.—*Observer*, M. W. TATTAM.

ISLEWORTH, *November 4th.*—The observer has had some trees cut down, so that there is now no obstruction to the rain-gauge. All the instruments were in good condition.—*Observer*, Miss E. A. ORMEROD, F.M.S.

KENILWORTH, *September 28th.*—The instruments are placed on a grass plot in the garden of Lynton Villa, in an open and exposed situation, especially

from East to West-south-west. The ground falls slightly from North-north-west to South-south-east. The soil is gravel, on clay.—*Observer*, F. SLADE, Assoc.M.Inst.C.E., F.M.S.

LOWESTOFT, *September 4th.*—Since the last inspection Mr. Miller has removed to the other side of the Yarmouth Road, about 200 ft. South of his former house. The vegetable garden, in which the instruments are exposed, is more confined than the previous one, and is surrounded by a wall 6 ft. high. The instruments were all in good condition. The soil is gravel.—*Observer*, S. H. MILLER, F.M.S.

MAKER, *July 24th.*—The instruments were in good order, and were very clean. The rain-gauge has been moved to the position selected for it at the last inspection.—*Observer*, Rev. P. H. NEWNHAM, M.A., F.M.S.

MARGATE, *June 30th.*—This station is at Apsley House School, close to East Margate railway station, and about ½ mile from the sea on the North. The instruments are well exposed on the lawn. The nearest object is the house 30 ft. distant on the South-east, so that the thermometer screen is in the shade in the early morning during the winter. All the instruments were in a satisfactory condition. The soil is chalk.—*Observer*, J. STOKES, F.M.S.

PORTSMOUTH.—*August 22nd.*—The instruments have been moved a little to the West since the last inspection. As the thermometer screen was unsteady, the observer was requested to have the supports strengthened.—*Observer*, R. E. POWER, L.R.C.P.

RAMSGATE, *July 1st.*—The observations at St. Augustine's Monastery having been discontinued, Mr. Jackson has undertaken to establish a climatological station by August 1st. The instruments will be placed in a large kitchen garden in Crescent Road, which runs South-south-east and North-north-west. The exposure is very good and open, and a small grass plot will be laid down round the screen. The ground slopes from the South-west to North-east. The garden is about ¼ mile from the West Cliff. The soil is chalk.—*Observer*, M. JACKSON, F.M.S.

SIDMOUTH, *July 26th.*—Everything was in a satisfactory condition.—*Observer*, Dr. W. T. RADFORD, F.M.S.

SOMERLEYTON, *September 5th.*—All the instruments were in good order. The rain-gauge has been moved to the site selected at the last inspection.—*Observer*, Rev. C. J. STEWARD, M.A., F.M.S.

SOUTHAMPTON, *August 17th.*—As the thermometer screen was not well exposed, being rather overshadowed by shrubs, the observer undertook to cut down a tree and remove the screen to a better situation. An earth thermometer at 1 ft. below the surface has been added to the equipment.—*Observer*, Rev. H. GARRETT, M.A., F.M.S.

SOUTHBOURNE-ON-SEA, *August 17th.*—All the instruments were in good order.—*Observer*, Dr. T. A. COMPTON, F.M.S.

SOUTHEND, *July 6th.*—The thermometer screen is placed over grass in a garden about 35 ft. long by 43 ft. wide, surrounded by a wall 4 ft. high. The exposure is open, except on the South-west, where the house, 30 ft.

distant, shades the screen in the afternoon during winter. The screen, a home-made one, much larger than a Stevenson, is square and double-louvred, and has a pyramidal roof. The zéro of the maximum thermometer was 1°·2 higher than when verified in 1873. The rain-gauge is in an enclosure near a pond at the Waterworks, in a very open situation. Both the thermometer screen and the rain-gauge are about 800 yds. from the river, and ¼ mile apart. The soil is clay.—*Observer*, G. LINGWOOD, F.M.S.

SOUTH NORWOOD (CUMBERLOW), *August 11th.*—The instruments are on a slope near the bottom of Norwood Hill, in a spot formerly used as a brick-field, but which has recently been laid out as pleasure grounds, and which, probably, in the course of a few years, will be overshadowed by shrubs and trees. The thermometer screen was much too low, the bulbs of the dry, wet and minimum thermometers being only 3 ft. 4 ins. above the ground, while the maximum thermometer was placed at the top (near the roof) of the screen, 4 ft. above the ground. The screen had received one coat of white paint, but required another. The rain-gauge is on the top of the slope, which faces South-south-west. The observer was requested to procure another gauge, and place it in a better position. The soil is clay.—*Observer*, W. F. STANLEY, F.M.S.

SWANAGE, *August 18th.*—The thermometers are in a very open situation in a field in Durleston Park, on the summit of a hill on the South side of Swanage Bay. The screen is about 200 ft. from the cliff on the East, and 178 ft. above the sea. The rain-gauge is in the garden of Rochford House, at a lower elevation, and not so well exposed. The sub-soil is Purbeck stone.—*Observer*, B. JUMEAUX, L.R.C.P., F.M.S.

SWARRATON, *August 23rd.*—Everything appeared to be in good order. The thermometer screen, however, required fresh painting.—*Observer*, Rev. W. L. W. EYRE, M.A., F.M.S.

TEIGNMOUTH (BITTON), *July 27th.*—On January 1st the thermometer screen was removed from the Bitton grounds to the small garden in front of Dr. Lake's house. The exposure is not so good as formerly, being mostly in the shade. The thermometer screen greatly needed repairing and painting. The rain-gauge has been removed to the garden of Marina House on a level with the Den. The gauge is well exposed, about 18 ft. above sea-level.—*Observer*, Dr. W. C. LAKE, F.M.S.

TEIGNMOUTH (WOODWAY), *July 27th.*—The thermometers were all correct, except the minimum, which had gone down 0°·3. The observer undertook to have the screen fresh painted in the autumn.—*Observer*, G. W. ORMEROD, M.A., F.M.S.

TORQUAY (CASTLE COLLEGE), *July 28th.*—The instruments were in a fairly good condition. The screen greatly needed painting and repairing, which, however, was done the day after my visit.—*Observer*, C. J. HARLAND, F.M.S.

TORQUAY (ROCOMBE), *July 31st.*—The instruments were in good order.—*Observer*, H. HEARDER.

TUNBRIDGE, *September 25th.*—The garden in which the instruments are placed is not surrounded by a wall 7 feet high, as stated in the last report;

the walls are on the West-south-west and South-south-east sides, the house being on the East, and a hedge on the North-north-west. The situation is rather confined by shrubs.—*Observer*, W. C. Punnett, F.M.S.

Tunbridge Wells, *September 25th.*—The instruments were all in a satisfactory condition.—*Observer*, F. Green, M.A., F.M.S.

Ventnor, *August 21st.*—All the instruments were in good order. The thermometers agreed with their certificates, except the minimum which had become 0°·8 too low.—*Observer*, H. Sagar.

Watford, *September 28th.*—No change has been made since the last inspection. The instruments were in a satisfactory condition.—*Observer*, J. Hopkinson, F.M.S.

Weston-super-Mare, *July 18th.*—The thermometer screen has been moved a few feet further West into a field, of which a portion has been railed off. The exposure is exceedingly open. As the screen was liable to vibrate in strong winds the observer was requested to put up some stays to steady it.—*Observer*, W. E. Perrett.

Weymouth, *August 19th.*—This station has been organised and equipped by the Corporation, under the superintendence of Mr. T. B. Groves. The observations are made by a N.C. officer of the Royal Engineers. The instruments are on a grass plot in a small vegetable garden on the Nothe, 80 ft. above the sea and immediately overlooking the harbour. The Nothe is a peninsula running Eastward, at the end of which is a fort, and is about ¼ mile broad. The instruments are on the Northern side, about 80 ft. from the cliff: the ground rises to the South. The instruments were in good order; but a slight re-arrangement of their position in the screen was suggested.—*Observer*, Sergeant J. Evans, R.E.

Worthing, *September 26th.*—This station was in a satisfactory condition. An earth thermometer at a depth of 1 ft. below the surface has been added to the equipment. It is proposed shortly to establish a sunshine recorder.—*Observer*, W. J. Harris, M.R.C.S., F.M.S.

APPENDIX III.

Obituary Notices.

Dr. Henry Dodgson, who died on the 10th of July, at Derwent House, Cockermouth, in the full vigour of manhood, after a few days' illness, was born in that neighbourhood in 1833, of an old Cumberland family. He studied at the Universities of Edinburgh and Paris, graduating M.D. at Edinburgh in 1856. Since then he practised in Cockermouth and the neighbourhood for many miles round. The writer of this notice, who knew him well a quarter of a century ago, cherishes among his fondest memories his bright and manly expression united with great modesty and moral purity. Dr. Dodgson was a Major of Volunteers, a Freemason, and one of the best officers in the county, and Past Grand Senior Deacon of his Province.

Dr. Dodgson commenced regular meteorological observations in 1861, and continued them uninterruptedly to the time of his death. Besides the ordinary

routine of a complete second order station, he made various extra observations on the decrease of rainfall with elevation, on evaporation, and other subjects.

Vice-Admiral MATTHEW STAINTON NOLLOTH, F.R.G.S., entered the Navy in 1824, became a Sub-Lieutenant in 1830, and was promoted to a Lieutenancy in 1838. As senior Lieutenant of the *Childers* he served in 1843 in China, and distinguished himself in the operations in Yang-tse-Kiang. He also rendered valuable services in taking possession of the fortified town of Truxillo in 1852, for which he received the high approbation of Lord Palmerston, the then Foreign Secretary. His subsequent promotions were—Commander, 1846; Captain, 1856; retired Rear-Admiral, 1874; and Vice-Admiral, 1879. In 1874 he attended the Conference on Maritime Meteorology, held in London, as the representative of the Admiralty. He died on the 10th of May, 1882, in his 72nd year.

He was an old observer for the late Admiral FitzRoy, and a log of H.M.S. *Frolic*, under his command, is the fourth in the list of the Meteorological Office. It, and the subsequent logs sent in by him, contained valuable information on the tracks of hurricanes, &c., collected by the Captain.

Professor EMIL PLANTAMOUR was born at Geneva in 1815, and died there on the 7th of September, 1882, as Director of the Observatory and Professor of Astronomy—a post which he had held for 43 years, having been appointed at an early age to succeed his former teacher, Alfred Gautier.

This Society has not so much to do with his astronomical and geodetical labours, which justly made him famous. In our own science the *Mémoires du Climat de Genève*, 1863, and *Nouvelles études sur le climat de Genève*, 1876, were his principal works; but his *Resumé Météorologique pour Genève et le Grand St. Bernard*, which appeared regularly for many years, forms a most valuable contribution to the knowledge of Alpine meteorology.

He was one of the Swiss Meteorological Council, and was the representative of his Government to the Congresses of Vienna and Rome, where his perfect command of German and English rendered his assistance of the greatest value. In conducting the discussions at the last-named Congress he took a decided part in protesting against the danger of neglecting climatology too much in the seductive pursuit of weather study. He leaves in the ranks of meteorologists a gap which it will be hard to fill.

He was for many years one of the editors of the *Bibliothèque Universelle*, and in the *Archives des Sciences de Genève, Physiques et Naturelles*, for the 15th of April, 1883, will be found a biographical notice of him.

CHARLES VINCENT WALKER, F.R.S., was appointed Telegraph Engineer to the South Eastern Railway in October 1845, and held this office till the day of his death. In his Presidential Address to the Society of Telegraph Engineers, on the 12th of January, 1876, Mr. Walker said, "Looking back to this distant date, I cannot help thinking that I must be the oldest Telegraph Engineer in England,—at least the one longest in tenure of the selfsame office,—the one who has had sole charge as Resident Engineer of the same

working system of electric telegraphs for the longest term of years." In this Address Mr. Walker gave a sketch of the telegraph system of the South Eastern Railway, and at the same time his own connection therewith. He was a zealous worker in the science of electricity, and was the inventor of several useful appliances in connection with telegraphy, including the instruments by which the block-system on railways is worked. He was the first to adopt the method of covering telegraph wires, which pass through tunnels, with a coating of gutta-percha. Mr. Walker also invented an instrument for the better protection of telegraph stations from atmospheric electric discharges; and was the patentee of the electric communicator between guard and passengers on railway trains. He was associated with Sir G. B. Airy in originating the distribution of Greenwich time by telegraph. Mr. Walker was the most active member of, and for some years Secretary and Treasurer of, the London Electrical Society. He was also editor of its *Proceedings*, and, on the winding-up of the Society, he started the *Electrical Magazine*, two volumes of which only were published (1843-46).

Mr. Walker was the author of *Electrotype Manipulation* (1837), *Electric Telegraph Manipulation* (1850), and a number of papers on electricity. He also translated Kaemtz's *Complete Course of Meteorology* (1844), and De La Rive's *Treatise on Electricity*, 3 vols. (1853-8); and edited *Lardner's Manual of Electricity, Magnetism and Meteorology* (1844).

Mr. Walker was elected into this Society on the 4th of June, 1850, served on the Council from 1854 to 1876, held the office of Secretary from 1857 to 1864, and was President in 1869 and 1870. He was largely instrumental in inducing the Council to publish the *Proceedings*, of which he was editor from 1861 to 1864.

He died at his residence at Tunbridge Wells, on the 24th of December, 1882, in the seventy-first year of his age.

APPENDIX IV.

List of Books Purchased.

Adams, J.—Extracts from a Meteorological Journal kept at Edmonton, Middlesex. 8vo. (1814.)

Belville, J. H.—A Manual of the Thermometer. 8vo. (1850.)

————.—Meteorological Journals kept at Greenwich, 1811-1856 (MS.)

Bryson, R.—Description of a new self-registering Barometer. 4to. (1844.)

Dampier, Capt. W.—A New Voyage round the World. Two Vols. 3rd Edition. 8vo. (1698-9.)

De Luc, J. A.—Recherches sur les Modifications de l'Atmosphère. Four Vols. New Edition. 8vo. (1784.)

Deutsche Seewarte.—Atlantischer Ozean. Ein Atlas von 36 Karten. Imperial Folio. (1882.)

Encyclopædia Britannica.—Ninth Edition, Vol. XIV. 4to. (1882.)

Ferrel, W.—Meteorological Researches. Part II. On Cyclones, Tornadoes, and Waterspouts. 4to. (1880.)

Giles, S.—Meteorological and Statistical Guide. Second Edition. 8vo. (1863.)

Howard, L., F.R.S.—Barometrographia, 1815-1834. Charts. (1847.)

Hutchison, G.—An Essay on the Nature and Cause of the Diurnal Oscillations of the Barometer. 12mo. (1844.)

KING, REV. Dr. J. G., F.R.S.—Observations on the Climate of Russia and the Northern Countries. 4to. (1778.)

MACKENZIE, G.—Manual of the Weather for the years 1830 and 1831. 12mo. (1829-30.)

MURPHY, P.—Observations on the Laws and Cosmical Dispositions of Nature in the Solar System. 12mo. (1843.)

PARNELL, MAJOR A.— The Action of Lightning. 12mo. (1882.)

POUILLET, C. S. M.—Eléments de Physique Expérimentale et de Météorologie. Seventh Edition. Two Vols. and Plates. 8vo. (1856.)

ROYAL SOCIETY.—Proceedings, Vols. VIII.-XVI. 8vo. (1856-68.)

SAXBY, S. M.—Saxby's Weather System. Second Edition. 8vo. (1864.)

SCHLAGINTWEIT, Dr. H. DE.—Numerical Elements of Indian Meteorology. 4to. (1863.)

SIX, J., F.R.S.—The construction and use of a Thermometer for showing the extremes of Temperature. 8vo. (1794.)

"TIMES" REGISTER OF EVENTS in 1881. 8vo. (1882.)

TOMLINSON, C.—The Thunder-Storm. 8vo.

WEATHER WISDOM.—16mo.

WOODS, J.—Elements and Influences of the Weather. 8vo. (1861.)

APPENDIX V.

DONATIONS RECEIVED FROM JANUARY 1ST, TO DECEMBER 31ST, 1882.

Presented by Societies, Institutions, &c.

ADELAIDE, OBSERVATORY.—Meteorological Observations, 1879.

BATAVIA, OBSERVATORY.—Magnetical and Meteorological Observations, 1879 and 1880.—Rainfall in the East Indian Archipelago, 1880 and 1881.

BERLIN, K. PREUSS-STATISTISCHES BUREAU.—Preussiche Statistik LXIV. Ergebnisse der meteorologischen Beobachtungen im Jahre 1881.

BOMBAY, METEOROLOGICAL OFFICE.—Brief Sketch of the Meteorology of the Bombay Presidency in 1880.

BRISBANE, GENERAL REGISTER OFFICE.—Report on the Vital Statistics, Sept. 1881, to Sept. 1882.

BRUSSELS, OBSERVATOIRE ROYAL.—Bulletins Météorologiques, Dec. 1881 to Nov. 1882.

CAIRO, SOCIÉTÉ KHÉDIVIALE DE GÉOGRAPHIE.—Bulletin, No. 12, and Series II. No. 1.

CALCUTTA, METEOROLOGICAL OFFICE.—Indian Meteorological Memoirs, Vol. I.—Report on the Administration of the Meteorological Department of the Government of India in 1880-81.—Registers of Original Observations reduced and corrected, Aug. 1880 to Dec. 1881.—Report on the Meteorology of India in 1879 and 1880. By H. F. Blanford, F.R.S.—Observations on the Meteorology of Secunderabad for the year 1864. By Dr. W. A. Smith.

CALCUTTA, ST. XAVIER'S COLLEGE OBSERVATORY.—Meteorological Observations, July 1881 to June 1882.

CAPE TOWN, METEOROLOGICAL COMMISSION.—Report for the year 1881.

CAPE TOWN, SOUTH AFRICAN PHILOSOPHICAL SOCIETY.—Transactions, Vols. I. and II.

CHRISTIANIA, NORSKE METEOROLOGISKE INSTITUT.—Beretning, 1881.—Jahrbuch für 1881.—Oversigt over Veirforholdene i Norge i Aaret, 1881.

CHRISTIANIA, NORWEGIAN NORTH ATLANTIC EXPEDITION, 1876-8.—Astronomical Observations, Geography, and Natural History, by H. Mohn.—Magnetical Observations, by C. Wille.—Historical Account, and the Apparatus and how used, by Capt. C. Wille.—Zoology: Holothurioidea, by D. C. Danielssen and Johan Koren; Annelida, by G. A. Hansen.

COPENHAGEN, DANSKE METEOROLOGISKE INSTITUT.—Bulletin Météorologique du Nord, Dec. 1881 to Nov. 1882.

CRACOW, K. K. STERNWARTE.—Meteorologische Beobachtungen, Dec. 1881 to Oct. 1882.

DUBLIN, GENERAL REGISTER OFFICE.—Seventeenth detailed Annual Report of the Registrar-General of Marriages, Births, and Deaths in Ireland, 1880.—Weekly Returns of Births and Deaths Vol. XVIII. No. 51 to Vol. XIX. No. 50.

DUBLIN, ROYAL DUBLIN SOCIETY.—Scientific Proceedings, Vol. II. (New Series) Part 7; Vol. III. Parts 1 to 4.—Scientific Transactions, Vol. I. (Series II.) Nos. 13 and 14.

DUBLIN, ROYAL IRISH ACADEMY.—Proceedings, Science, Vol. III. Ser. II. Nos. 7 to 8;—Polite Literature and Antiquities, Vol. II. Ser. II. No. 3.—Transactions, Science, Vol. XXVIII. Papers 6 to 10.

EDINBURGH, GENERAL REGISTER OFFICE.—Quarterly Returns of the Births, Deaths, and Marriages in Scotland for the four quarters ending Sept. 30th, 1882.

EDINBURGH, ROYAL SOCIETY.—Proceedings, Nos. 108 and 109.

EDINBURGH, SCOTTISH METEOROLOGICAL SOCIETY.—Journal, Nos. LXIV. to LXIX.

FIUME, I. R. ACCADEMIA DI MARINA.—Meteorological Observations, Nov. 1881 to Oct., 1882.

GENEVA, SOCIÉTÉ DE GÉOGRAPHIE.—Le Globe. Tome XX. Liv. 6 and 7; Tome XXI. Memoirs, Nos. 1 to 3; Bulletin, Nos. 1 to 3.

GREENWICH, ROYAL OBSERVATORY.—Magnetical and Meteorological Observations, 1880.—Report of the Astronomer Royal to the Board of Visitors, 1882.

HAMBURGH, DEUTSCHE SEEWARTE.—Meteorologische Beobachtungen in Deutschland für 1880.—Monatliche Uebersicht der Witterung, Dec. 1879, and Aug. 1881 to June 1882.—Wetterbericht, 1882.

KEW, OBSERVATORY.—Reports of the Kew Committee for the years ending Oct. 31, 1880 and 1881.

LEIPZIG, K. S. METEOROLOGISCHES BUREAU.—Die Ergebnisse der Nieder-schlags-Beobachtungen in Leipzig und an einigen anderen sächischen Stationen von 1864-1881, von Dr. A. von Danckelman.

LEON DE ALDAMAS (MEXICO), COLEGIO.—Resumen Meteorologico, Jan. to Oct. 1882.

LISBON, SOCIEDADE DE GEOGRAPHIA DE LISBOA.—Boletin, 3rd Series, Nos. 4 and 5.

LONDON, COLONIAL OFFICE.—Minutes of Proceedings of the Intercolonial Meteorological Conferences held at Sydney in 1879 and at Melbourne in 1881.—Annual Report of the Director of the Royal Alfred Observatory, Mauritius, for 1881.

LONDON, GENERAL REGISTER OFFICE.—Annual Summary of Births, Deaths, and Causes of Death in London and other large cities, 1881.—Quarterly Returns of Marriages, Births and Deaths for the four quarters ending Sept. 30, 1882.—Weekly Returns of Births and Deaths, Vol. XLII. No. 52 to Vol. XLIII. No. 51.

LONDON, INDIA OFFICE.—The Cyclone in the Bay of Bengal in June 1872. By W. G. Willson.—Meteorological Observations at Dodabetta, 1847-48. By J. G. Taylor, F.R.S. —Report on Observations of the Total Eclipse of the Sun on December 11-12, 1871. By Lt.-Col. J. T. Tennant, F.R.S.

LONDON, INSTITUTION OF CIVIL ENGINEERS.—On Resistance to Wind-Pressure. By Messrs. Bender and Gaudard.

LONDON, METEOROLOGICAL OFFICE.—Bataille de Fleurus, 26 Juin, 1794. Picture showing Captive Balloon.—Beiträge zur meteorologischen Optik und zu verwandten Wissenschaften. In zwanglosen Heften herausgegeben von Prof. J. A. Grunert. Theil I. Hefte 1-4.—Bericht über die Verhandlungen des internationalen meteorologischen Comités. Versammlung in Bern vom 9 bis 12 August 1880.—Bulletin des observations françaises Saint-Martin-de-Hinx, 1878, 1879.—Bulletin Météorologique du Laboratoire de Chimie du Caire, Jan. 7 to 28, 1882 (MS.).—Bulletin quotidien de l'Algérie, Dec. 16, 1881, to Nov. 30, 1882.—Contributions to our knowledge of the Arctic Regions, Part III.—Daily Weather Reports, 1882.—Die barometrischen Höhenmessungen und ihre bedeutung für die Physik der Atmosphäre. Von Dr. Richard Ruhlmann.—Hourly Readings, Oct. 1880 to March 1881.—XIII. Jahresbericht der Grossh. Badischen meteorologischen Centralstation Karlsruhe für das Jahr 1881.—Le Service Météorologique du Gouvernement Général de l'Algérie. Par Capt. H. Brocard.—Meteorological Charts of the Ocean District adjacent to the Cape of Good Hope, with Remarks.—Meteorological Observations at Stations of the Second Order for the year 1879.—Meteorological Observations taken at Southport, July, 9, 1881, to April 14, 1882.—Normalörter für die Taifune in den chinesischen und japanischen Meeren des Jahres 1881. Von E. Knipping.—Observations Météorologiques faites à Saint-Martin-de-Hinx (Landes) du 1er Déc. 1864 au 30 Nov. 1880. Par H. Carlier.—Observations Météorologiques faites à Saint-Martin-de-Hinx, France (Landes). Par H. Carlier, Déc. 1, 1875, au Nov. 30, 1878, et Dec. 1, 1879, au Nov. 30, 1881.—On the Results of Observations made at the Pagoda, Royal Gardens, Kew, and elsewhere, to determine the influence of height on Thermometric Readings, on Vapour Tension and on Humidity.—Quarterly Weather Report, 1879. Appendices and Plates.—Report of the Meteorological Council to the Royal Society, for the years ending 31st of March, 1881 and 1882.—Report on a Magnetic Survey of the Indian Archipelago, 1874-77. By Dr. van Rijckevorsel. Report on the Gales experienced in the Ocean District adjacent to the Cape of Good Hope. By Capt. H. Toynbee.—Report on the Storm of October 13-14, 1881.—Sechsundsechszigster Jahresbericht der naturforschenden Gesellschaft im Emden, 1880-81.—Tafel der mittleren Temperaturen verschiedener Orte in Réaumur'schen Graden. Berechnet von Dr. H. W. Dove.—Washington Astronomical Observations, 1875.—Ueber ein neues Hygrometer; von Prof. E. H. von Baumhauer.—Ueber die Bewegungen der Wärme in Erdschichten von verschiedener geognostischer Beschaffenheit.—Weekly Weather Reports. Vol. IV. No. 51 to Vol. V. No. 50.—Western Australia Meteorological Report for the year 1881.

LONDON, PATENT OFFICE.—Patents for Inventions. Abridgements of Specifications relating to Optical, Mathematical, and other Philosophical Instruments.

LONDON, ROYAL AGRICULTURAL SOCIETY.—Journal. New Series. Vol. XVIII. 1882.

LONDON, ROYAL ASTRONOMICAL SOCIETY.—Memoirs. Vol. XLVI. 1880-1.—Monthly Notices. Vol. XLII. No. 2 to Vol. XLIII. No. 1.

LONDON, ROYAL BOTANIC SOCIETY.—Quarterly Record, Nos. 8 to 11.

LONDON, ROYAL INSTITUTION OF GREAT BRITAIN.—Proceedings, No. 74.

LONDON, ROYAL SOCIETY.—Proceedings, Nos. 216 to 221.

LONDON, SANITARY INSTITUTE OF GREAT BRITAIN.—Transactions. Vol. III.

LONDON, SOCIETY OF ARTS.—Journal, Nos. 1520 to 1571.

LONDON, SOCIETY OF PUBLIC ANALYSTS.—The Analyst, Jan. to Dec. 1882.

LONDON, SOCIETY OF TELEGRAPH ENGINEERS AND ELECTRICIANS.—Journal, Nos. 39 to 44.—Index of Publications.

LONDON, WAR OFFICE.—Army Medical Department Report for the year 1880.

MADRID, OBSERVATORIO ASTRONOMICO Y METEOROLOGICO.—Las Tempestades en Espana, Avril 30 al Julio 31, 1882.

MADRID, SOCIEDAD GEOGRAPHICA.—Boletin. Tomo XI. No. 6 to Tomo XIII. No. 5.

MARLBOROUGH COLLEGE, NATURAL HISTORY SOCIETY.—Report for 1881.

MELBOURNE, OBSERVATORY.—Monthly Record of Results of Observations in Meteorology, Terrestrial Magnetism, &c., Feb. to Dec. 1881.

MELBOURNE, ROYAL SOCIETY OF VICTORIA.—Transactions and Proceedings. Vol. XVIII.

METZ, ACADÉMIE.—Observations Météorologiques faites à Metz pendant les années 1878 et 1879.

MEXICO, MINISTERIO DE FOMENTO.—Anales. Tomos V and VI.—Revista Mensual Climatologica. Tomo I. Nos. 9 to 13.—Boletin. Tomo VI. Nos. 133 to 179; 185 to 198. Tomo VII. Nos. 1 to 75; and 77 to 95.

MICHIGAN, STATE BOARD OF HEALTH.—Annual Report, 1880 and 1881.—Annual Reports relating to the Registry and Return of Births, Marriages, and Deaths in Michigan for the years 1875 and 1876.—Meteorological Report, from Observations made at Lansing, Oct. 30, 1881, to Oct. 21 and Oct. 29 to Dec. 9, 1882.—Michigan Crop Report, March to Nov., 1882.

MILAN, REALE OSSERVATORIO DI BRERA.—Operazioni eseguite nell' anno 1879 per determinare la differenza di longitudine fra gli Osservatori Astronomici del Campidoglio in Roma e di Brera in Milano. Resoconto dei Professori Lorenzo Respighi e Giovanni Celoria.—Osservazioni di Stelle Cadenti fatte nelle Stazioni Italiane durante gli anni 1868, 1869 e 1870.—Osservazioni Meteorologiche Orarie ottenute da Strumenti Registratori durante l' anno 1880.

MILAN, R. SPECOLA DI BRERA.—Osservazione Meteorologiche, 1880, 1881.

MONCALIERI, ASSOCIAZIONE METEOROLOGICA ITALIANA.—Bollettino Decadico pubblicato per cura dell' Osservatorio Centrale del Real Collegio Carlo Alberto in Moncalieri, Oct. 1881, to July, 1882.—Bollettino Mensuale. Serie II., Vol. I., No. 9 to Vol. II., No. 6.

MONTREAL, GEOLOGICAL SURVEY OF CANADA.—Report of Progress for 1879—80.

MUNICH, K. B. METEOROLOGISCHE CENTRAL STATION.—Beobachtungen der meteorologischen Stationen im Kon. Bayern. Jahrgang III., Heft 4 to Jahrgang IV., Heft 2.—Uebersicht über die Witterungsverhältnisse im Kon. Bayern., Dec., 1881, to April and June to Oct., 1882.

MUNICH, K. STERNWARTE.—Meteorologische und magnetische Beobachtungen, 1881.

NEWHAVEN, CONNECTICUT ACADEMY OF ARTS AND SCIENCES.—Transactions. Vol. IV., Part 2; Vol. V., Part 2.

NEW YORK, CENTRAL PARK OBSERVATORY.—Abstracts of Registers from Self-Recording Instruments, Dec., 1881, to Oct., 1882.

OXFORD, RADCLIFFE OBSERVATORY.—Results of Meteorological Observations made in the year 1880.

PARIS, BUREAU CENTRAL MÉTÉOROLOGIQUE.—Bulletin International 1882.—Rapport du Comité Météorologique International. Réunion de Berne, 1880.

PARIS, L'OBSERVATOIRE DE MONTSOURIS.—Annuaire, 1882.

PARIS, SOCIÉTÉ MÉTÉOROLOGIQUE DE FRANCE.—Annuaire, 1881, and Jan. and Feb., 1882.

PHILADELPHIA, AMERICAN PHILOSOPHICAL SOCIETY.—Proceedings, No. 109.

PRAGUE, K. K. STERNWARTE.—Astronomische, magnetische, und meteorologische Beobachtungen im Jahre 1881.

RIO DE JANEIRO, L'OBSERVATOIRE IMPÉRIAL.—Bulletin Astronomique et Météorologique, July, Aug. and Oct. 1881, to Sept. 1882.

ROME, UFFICIO CENTRALE DI METEOROLOGIA.—Bollettino Mensile, Dec. 1880 to June 1881.

ST. PETERSBURG, KAISERLICHEN AKADEMIE DER WISSENSCHAFTEN.—Communications from the International Polar Commission. Edited by H. Wild. Parts 1 to 3.

ST. PETERSBURG, PHYSIKALISCHES CENTRAL OBSERVATORIUM.—Annalen, 1880; and 1881. Part 1.

STONYHURST, COLLEGE OBSERVATORY.—Results of Meteorological and Magnetical Observations, 1881.

SYDNEY, GOVERNMENT OBSERVATORY.—Double Star Results, 1871 to 1881.—Results of Rain and River Observations made in New South Wales during 1881.

SYDNEY, ROYAL SOCIETY OF NEW SOUTH WALES.—New South Wales in 1881. By T. Richards.—Journal and Proceedings, 1881. Vol. XV.

TIFLIS, PHYSIKALISCHE OBSERVATORIUM.—Magnetische Beobachtungen im Jahre 1880.

TOKIO, UNIVERSITY.—Memoirs of the Science Department, No. 5.—Measurements of the force of Gravity at Tokio and on the summit of Fujinoyama. By Professor T. C. Mendenhall.

TORONTO, MAGNETIC OBSERVATORY.—General Meteorological Register for 1881.

TORONTO, METEOROLOGICAL OFFICE.—Monthly Weather Review. Jan. to Oct. 1882.—Report of the Meteorological Service of the Dominion of Canada for the year 1880.

UPSALA, OBSERVATOIRE DE L'UNIVERSITÉ.—Bulletin Météorologique Mensuel, Jan. to Dec. 1881.

UTRECHT, K. NEDERLANDSCH METEOROLOGISCH INSTITUUT.—Meteorologisch Jaarboek voor 1881.

VIENNA, K. K. CENTRALANSTALT FÜR METEOROLOGIE UND ERDMAGNETISMUS.—Beobachtungen, Nov. 1881 to 1882.—Jahrbuch, 1878.

VIENNA, OESTERREICHISCHE GESELLSCHAFT FÜR METEOROLOGIE.—Zeitschrift, Jan. to Dec. 1882.

WASHINGTON, CHIEF SIGNAL OFFICE.—Chronological List of Auroras observed from 1870 to 1879. Compiled by Lieut. A. W. Greely.—Information relative to the Construction and Maintenance of Time-Balls.—Isothermal Lines of the United States, 1871-80. By Lieut. A. W. Greely.—Monthly Weather Review, Sept. to Dec. 1880; Feb. to Aug. and Nov. 1881; and Jan. to March and Sept. 1882.—Report on the Character of Six Hundred Tornadoes. By Sergt. J. P. Finley.—Report on the Solar Eclipse of July, 1878. By Prof. C. Abbe.—The reduction of Air-Pressure to Sea-Level, at elevated stations west of the Mississippi River. By H. A. Hazen, A.M.

WASHINGTON, SMITHSONIAN INSTITUTION.—Annual Report 1880.—List of Foreign Correspondents corrected to January 1882.

WATFORD, HERTFORDSHIRE NATURAL HISTORY SOCIETY.—Transactions. Vol. I. Parts 8 and 9.

WELLINGTON, REGISTRAR-GENERAL'S OFFICE.—Statistics of the Colony of New Zealand for the year 1880.

ZURICH, METEOROLOGISCHE CENTRALANSTALT DER SCHWEIZERISCHEN NATURFORSCHENDEN GESELLSCHAFT.—Schweizerische meteorologische Beobachtungen, 1879, Parts 6 and 7; 1880, 5 to 7; 1881, 1 to 4.

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AITKEN, J., F.M.S.—Rainfall in 1881 at Braemar, Aberdeenshire.

ALDRIDGE, E. G., F.M.S.—The Weather of November 1881.—The Winter of 1881-82.

AUGUSTIN, DR. F.—Ueber den täglichen Gang des Luftdruckes und der Lufttemperatur in Prag.—Ueber den täglichen Gang des Regenfalles.

BINYON, J. B.—Rainfall 1865 to 1881 at Blackrock, near Cork.—Rainfall, &c., at Blackrock, Dec. 1881 to Nov. 1882.—Remarks on the Weather of 1881 at Blackrock.

BLAKE, J. H.—On the Conservancy of Rivers, Prevention of Floods, Drainage and Water Supply.

BOLTON, C. P., F.M.S.—Rainfall at Halfway House, County Waterford, 1881.

BROCARD, CAPT. H.—Mémoires de Météorologie Dynamique. Exposé des Résultats de la Discussion des Cartes du Temps des Etats-Unis ainsi que d'autres documents, par Prof. E. Loomis.

BUCHAN, A., M.A.—The Climate of the British Islands.—The Meteorology of Rothesay.—The Weather and Health of London.

BURDER, DR. G. F., F.M.S.—On the Decrease of Rain with Elevation.

CAPRON, J. R., F.M.S.—Meteorological Readings taken at Guildown, Guildford, during 1881.

CHADBURN AND SON, MESSRS.—Description of an Anemometer capable of measuring the speed of air in heated flues.

CLARKE, R. A.—Meteorological Observations taken at Casterton, Aug. to Dec. 1881. (MS.)

CUNNINGHAM, D.—The Weather and Storms of Great Britain.

DENZA, P. F.—Anemographo e Pluviografo.—Anemometrographo alla specola seminario di Alessandria del C. P. Parnisetti.—Apparecchio Registratore velocità e diverzione del vento. Nota del Prof. F. Brusotti.

DICKSON, E. B.—Weather Report, Auckland, New Zealand, 1881.

DOWSON, E. T., F.M.S.—Transactions of the Norfolk and Norwich Naturalists' Society, 1874-1877.

FINEMAN, C. G.—Index to the Meteorological Publications from Sweden, 1856-1881.

FOX, W. L., F.M.S.—Tables of Sea Temperature and Bright Sunshine, &c., at Falmouth, 1881; including Meteorological Tables for West Cornwall and the Scilly Islands.

GAMBLE, J. G., M.A., F.M.S.—Summer and Winter Temperature in South Africa.

GLYDE, E. E., F.M.S.—Abstract of Meteorological Observations made at Kirkham, Babbacombe, Torquay, during the year 1881.—Meteorological Summary, Jan. to Aug. 1882, made at Babbacombe, Torquay.

GUY, DR. W. A., F.R.S.—The Claims of Science to Public Recognition and Support.

HALL, J. J., F.M.S.—On a New Electro-Magnetic Anemometer.

HALL, MAXWELL.—Jamaica Rainfall, 1880 and 1881.—Jamaica Weather Report, Oct. 1881 to Oct. 1882.

HANKINSON, R. C.—Weather at Red Lodge, Southampton, Dec. 1881 to Nov. 1882. (MS.)

HANN, DR. J.—Ueber den Föhn in Bludenz.—Ueber die monatlichen und jährlichen Temperaturschwankungen in Oesterreich-Ungarn.—Ueber die Temperatur der südlichen Hemisphäre.

HARVEY, REV. C. W., F.M.S.—Rainfall in Herts, Dec. 1881 to Nov. 1882.—Report on the Rainfall in Hertfordshire in 1881.—Meteorological Observations taken at Throcking, Herts, during the year 1881.—The Gale of the 14th of October, 1881, and its effects in Hertfordshire.

HILDEBRANDSSON, DR. H. H.—Observations Météorologiques faites par l'Expédition de la Véga du Cap Nord à Yokohama par le Détroit de Behring.

HOLMES, R. L., F.M.S.—Abstract of Meteorological Observations taken at Bua, Fiji, 1881.

HOPKINSON, J., F.M.S.—Meteorological Observations taken at Wansford House, Watford, during the year 1880.—Reports on the Phenological Observations in Hertfordshire in 1879 and 1880.

HOSKINS, DR. S. E., F.R.S., F.M.S.—Elements of the Climate of Guernsey for 37 years, 1843 to 1879.—Meteorological Observations, Guernsey, Dec. 1881.

HUNTER, J., JUNR., F.M.S.—Meteorological Observations at Belper, during 1882.

LAKE, DR. W. C., F.M.S.—Fifth Report of the Committee on the Meteorology of Devonshire.

LAWES, SIR J. B.—On the Amount and Composition of the Rain and Drainage-Waters collected at Rothamsted, by Sir J. B. Lawes, Dr. J. H. Gilbert and R. Warrington.

LOOMIS, PROF. E.—Contributions to Meteorology, Sixteenth and Seventeenth Papers.

MACLEAR, CAPT. J. P., F.M.S.—Baguios. Memoria Redactada por la Comision Hidrográphica de Filipinas en 1874.—Essayo Historico sobre el Clima de Chile, por B. V. Mackenna.—Guia para o uso des Cartas dos Ventos e Correntes do Golpho de Giuné, por J. C. de Brito Capello.—Le Cyclone aux Tuamotu, 6 et 7 Février, 1878.—Results of the Magnetical, Nautical and Meteorological Observations made and collected at the Flagstaff Observatory, Melbourne, and at various stations in the Colony of Victoria, March 1858 to Feb. 1859.

MARRIOTT, W., F.M.S.—Meteorology; The Science of the Weather. A Lecture delivered at the Rochester Farmer's Club.

MAWLEY, E., F.M.S.—The Rosarian's Year Book, 1882—The Weather of 1881 as observed in the neighbourhood of London.—The Weather of Nov. 1881 to Oct. 1882, Meteorological Observations taken at Addiscombe, Croydon.

MCLANDSBOROUGH, J., F.M.S.—Meteorology of Bradford for 1881.

MERRIFIELD, DR. J., F.M.S.—Meteorological Summary, Plymouth, for the year 1881.

NICOL, DR. J., F.M.S.—Llandudno as a Health Resort.

NIPHER, PROF. F. E.—Magnetic Survey of Missouri. Fourth Annual Report.—On a property of the Isentropic Curve for a perfect Gas as drawn upon the Thermodynamic Surface of Pressure, Volume and Temperature.

ORMEROD, MISS E. A., F.M.S.—Diagrams of Insects injurious to Farm Crops.—Injurious Insects. A Paper read at a Meeting of the Richmond Athenæum.—Report of Observations on Injurious Insects during the year 1881, and a special report on Turnip-Fly.

PHILIPS, J. C., F.M.S—Traces from Self-Recording Aneroid during 1882. (MS.)

PLANTAMOUR, PROF. E.—Résumé Météorologique de l'Année 1880 pour Genève et le Grand Saint-Bernard.

POËY, PROF. A.—Les Courants Atmosphériques d'après les Nuages au point de vue de la prévision du temps.

POGSON, MISS E. I.—Administration Report of the Meteorological Reporter to the Government of Madras for the year 1881-82.

PRESTON, REV. T. A., M.A., F.M.S.—Wiltshire Rainfall, Dec. 1881 to Nov. 1882.

PRINCE, C. L., F.M.S.—Chart of the Rainfall at Manchester, 1867-28, by T. Hanson.—Observations upon the Temperature, Pressure and Rainfall of the Past

Winter (1881-82).—The illustrated account given by Hevelius in his "*Machina Celestis*" of the method of mounting his telescopes, and erecting an observatory. Reprinted from an Original Copy with some Remarks. By C. L. Prince.

RADFORD, DR. W. T., F.M.S.—Monthly and Annual Means of Temperature and Rainfall at Sidmouth, 1871-80. (MS.)

RAGONA, PROF. D.—Andamento Annuale della Oscillazione Diurna della Declinazione Magnetica.—Le Brinate da 7 a 13 Aprile, 1882.—L' Estate del 1881.—L' Inverno 1881-82.

RAMSAY, A., F.M.S.—The Scientific Roll. Vol. 1. Nos. 6 to 9.

ROTH, H. L., F.M.S.—Notes on Continental Irrigation.

RUSSELL, H. C., F.M.S.—Transit of Mercury, Nov. 8th, 1881.

SHAW, H. S. H., F.M.S.—Some Remarks on the Methods of Wind Measurement.

SILVER, S. W., F.M.S.—The Colonies and India, 1882.

SMYTH, PROF. C. PIAZZI.—Madeira Meteorologic.—Madeira Spectroscopic.

SYMONS, G. J., F.R.S., F.M.S.—British Rainfall, 1881.—Bristol Docks. "Dockising River Avon." Reports on Floods, &c.—English Rainfall, 1860.—Meteorological Tables, Truro, 1868.—Servizio Meteorico-Agrario. Anno III. Nos. 9 to 19.—Summary of a Meteorological Journal, kept by C. L. Prince at Uckfield in 1867, and at Crowborough Beacon in 1874.—Symons's Meteorological Magazine, Jan. to Dec. 1882.

TABBOTTON, M. O., F.M.S.—Meteorological Observations at Nottingham, 1881.

TAYLOR AND FRANCIS, MESSRS.—Taylor's Calendar of the Meetings of the Scientific Bodies of London for 1882-83.

THE EDITOR.—'Ciel et Terre,' Vol. II., No. 21, to Vol. III., No. 20.
" 'Nature,' Nos. 635 to 687.
" 'Telegraphic Journal and 'Electrical Review, Nos. 215 to 267.
" 'The Field Naturalist,' Nos. 1 to 4.'

TRIPE, Dr. J. W., F.M.S.—Rainfall and Climate in India. By Sir J. Fayrer, M.D., F.R.S.—The Sanitary Condition and Laws of Mediæval and Modern London.

TRIPP, C. U., F.M.S.—Burton-on-Trent Meteorological Summary for 1881.—Rainfall and Temperature at Altarnun, Cornwall, in 1881.

TURTLE, L.—Review of the Weather of 1881 at Aghalee, Co. Antrim.

TYRER, R., F.M.S.—The Meteorology of Cheltenham for 1881.

TYRER, W., F.M.S.—Rainfall at Mansfield, 1870-81. (M.S.)

WHITLEY, N., F.M.S.—Meteorological Tables for Penzance, 1860 to 1877.

APPENDIX VI.

REPORTS OF OBSERVATORIES, &c.

THE METEOROLOGICAL OFFICE. The late Professor H. J. S. Smith, F.R.S., Chairman of Council; Robert H. Scott, F.R.S., Secretary; Captain H. Toynbee, F.R.A.S., Marine Superintendent.

Marine Meteorology.—The Charts for the region lying near the Cape of Good Hope, which had been in preparation for several years, were published in the month of June, and they were followed, in the course of the autumn, by a "Report on the Gales," experienced in the same district, which had been drawn up by Captain Toynbee. The Charts of Sea Surface Temperature, mentioned in the last Report of the Society, have now been completed and are in the engraver's hands, so that they will appear in the course of the coming summer.

The Pressure Charts for all Oceans for the four cardinal months are in hand, as already mentioned, and may be expected to be finished in about a year.

The investigation into the weather of the North Atlantic for the period of thirteen months beginning with August 1882, has been adopted by the Council as the main work of the Marine Department, and it is being carried on vigorously. If it be permissible to quote figures relating to a date posterior to that of the Society's Report, the following statement may be found of interest as bearing on a subject on which the Society's Council has expressed decided opinions:—

"Up to the 23rd of February 1883, 1,062 vessels have co-operated in the work, and 3,116 forms have been received; they are distributed over the months as follows:—

Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.
630	630	590	494	451	249	72

The average number of days' observations received on each working day since

the 1st of November is 356, giving an average of 305 for each day since that date."

Part III. of the *Contributions to Arctic Meteorology* appeared in the month of October, and Mr. Strachan is now engaged on part IV., which will contain *inter alia* the data from the expeditions of M'Clure, Kellett and Nares, among British explorers, and of Kane, Hayes and Hall, among Americans.

Weather Telegraphy.—The operations in this department present no features of special novelty. The practical employment of *cirrus* observations in forecasting has made some advances, but difficulty is experienced in finding accurate recorders of so delicate an observation as the motion of upper clouds.

Land Meteorology.—Part II. of the *Quarterly Weather Report* for 1876 has appeared. It contains, as an Appendix, a comparison of the results, in the form of the constants of Bessel's Formula, obtained from the original Thermograms for the seven observatories in 1876 by the use of Thomson's Harmonic Analysis, with the results obtained by calculation from the mean values of the hourly readings of the same curves, as determined by Mr. H. S. Eaton (Presidential Address, 1878, *Quarterly Journal*, vol. iv. p. 87); the figures having kindly been placed at the disposal of the Council by Mr. Eaton.

The agreement between the two series of figures, which are represented graphically, is most satisfactory.

The engraved copies of the curves of the self-recording Instruments for the year 1879 have appeared, and are accompanied by an account of the comparison between the various modes of thermometric exposure conducted at Strathfield Turgiss between November 1868 and April 1870, by the Rev. C. H. Griffith, F.M.S.; the expenses of installation of the screens having been defrayed by grants obtained by Mr. G. J. Symons, F.R.S., from the Government Grant Committee.

The Council have commenced with the year 1881 the printing and publication of the hourly readings of the curves of their self-recording Observatories, which have been lithographed since 1874. Three quarterly parts have now appeared.

The Tables of Monthly Rainfall values for the British Isles for the fifteen years ending with 1880, which have been supplied to the Office by Mr. Symons, have now been printed, and will appear as soon as the map of total annual rainfall which has been engraved to accompany them is ready. The Meteorological Atlas of the British Isles is also in the hands of the engraver. It will embrace monthly maps of Atmospheric Pressure, Air Temperature and of Sea-Surface Temperature, and an annual map of Rainfall.

The Council have also engraved the daily records of sunshine for the year 1881 at thirty-one stations distributed over the United Kingdom, and the volume will appear in the course of the summer.

Lastly, it remains to say that the Council have decided to discontinue four of their observatories, viz. Armagh, Falmouth, Glasgow, and Stonyhurst, at the end of the current year, 1883, considering that, as the records will then have been continuously maintained for sixteen years, since the commencement of 1868, sufficient material has been collected for the determination of the most important elements of diurnal and annual range for the different districts of the United Kingdom. It is proposed to maintain the three observatories of Aberdeen, Kew, and Valencia, whose positions form approximately an equilateral triangle, as representing the extreme differences of situation to be met with in the United Kingdom.

ROYAL OBSERVATORY, GREENWICH. W. H. M. Christie, M.A., F.R.S., Astronomer Royal.—No important change has been made either in the meteorological instruments or in the meteorological work carried on at the Royal Observatory.

A small alteration has been made in the manner of connecting the pressure-plate of Osler's anemometer with the recording pencil. The communication was formerly effected by a copper wire passing down the centre of the long upright shaft. For this a fine brass chain has been substituted with great advantage; the record of pressure is altogether improved, the light pressures especially being much more satisfactorily registered.

A change has also been introduced as regards photography, the old wet-paper

process having been discarded for a dry process of much greater sensibility. The paper now employed is the "argentic-gelatino-bromide paper" prepared by Messrs. Morgan & Kidd, by use of which very much better results are in every way obtained, with a largely diminished consumption of gas.—*March 15th*, 1883.

ROYAL OBSERVATORY, EDINBURGH. Professor C. Piazzi Smyth, F.R.S.E., Astronomer Royal for Scotland.—The work of daily time signals, by both ball, gun, and controlled clocks, with the necessary observations, have been carried on as usual through the past year. Likewise the calculations of the bi-diurnal meteorological observations at fifty-five of the stations of the Scottish Meteorological Society, for the Registrar-General of Scotland. These have been printed in that officer's monthly and quarterly returns.—*Jan.* 1883.

KEW OBSERVATORY. G. M. Whipple, B.Sc., F.R.A.S., Superintendent.—The several self-recording meteorological instruments have been maintained in regular operation throughout the year.

The observations made on the lawn of the Observatory, with the view of determining the relative merits of different patterns of thermometer screens, were discontinued in November, 1881, the Wild's screen and the De La Rue portable screen having been dismounted and returned to the Meteorological Office. The Stevenson screen was, however, purchased by the Committee, and remains standing *in situ* for the purpose of exhibition to visitors, and also in order that occasional thermometric experiments may be conducted in it.

An exhaustive discussion of the twenty-eight months' observations has been made by the Superintendent, and submitted to the Meteorological Council at their request.

It may, however, be stated here that the results show that the observations of air temperature in the thermograph screen, attached to the Observatory building, only differ in the daily mean from those in a freely exposed Stevenson screen 4 ft. above the ground by 0°·4, and from a similarly placed Wild's screen, 10 ft. above the surface, by 0°·1. The extreme variations observed have, however, occasionally reached several degrees.

At the request of the Meteorological Council, the actinometer devised by Professor Balfour Stewart, and described in the *Report of the Committee on Solar Physics*, 1880, Appendix H, has been obtained on loan from the Science and Art Department, South Kensington, and erected on a suitable stand on the Observatory lawn. Numerous observations of solar radiation have been made by it during the past summer, and also several comparative observations have been made with the Hodgkinson's actinometers belonging to the Royal Society and to the India Office.

At the request of Mr. C. Greaves, M.Inst.C.E., several series of observations were taken at frequent intervals during last summer of the temperature of the surface of the pond a quarter of a mile distant from the Observatory. More recently a float has been moored in the centre carrying maximum and minimum thermometers immersed just below the water-line. This is hauled to the shore every morning at 9 a.m., and the temperatures recorded. The cost of the experiment is defrayed by Mr. Greaves.

Professor Tyndall having suggested the desirability of making a series of experiments on the fall of temperature near the surface of the ground at sunset, a scheme was organised and apparatus devised by Mr. F. Galton, by means of which thermometers suspended at heights of 2 ft., 4 ft., and 20 ft. could be rapidly read and their indications compared with those of a thermometer placed on swans' down on the surface of the ground.

The apparatus employed is conveyed into the open park to some distance from any building or trees, and the thermometers read at five-minute intervals from about half-an-hour before sunset until one hour or two hours after.

The cost of these experiments will be defrayed by a grant from the Meteorological Council.

Dr. Waldo, Director of the Thermometric Bureau of the Winchester Observa-

tory, U.S.A., has visited the Observatory, and selected several standard thermometers for use in that establishment in the verification of American thermometers, and for comparison with other instruments purchased of Continental makers.

Experiments have been made, but hitherto without complete success, for the direct comparison of chemical thermometers at high temperatures, an operation for which a demand has recently arisen amongst those who supply these instruments in commerce.

The number of instruments verified at the Observatory in the course of the year amounted to 7,544, being a considerable increase as compared with preceding years.—*Jan.* 11*th*, 1883.

RADCLIFFE OBSERVATORY, OXFORD.—E. J. Stone, M.A., F.R.S., Radcliffe Observer.—No important changes have been made in the instrumental equipment of the Observatory or in the arrangements for taking the meteorological observations since the date of the last report, but some working parts of the anemometer having become worn were renewed by Mr. Adie in October.

All the instruments are in good order, and the curves from the self-recording and photographic instruments are perfectly satisfactory.

The Meteorological Results for 1880 have been printed and distributed: those for 1881 are under discussion, some part being ready for press.

Weather reports have been supplied daily (by telegram) to the Meteorological Office; bi-monthly to the United States Signal Office; monthly to the Registrar General, *Midland Naturalist*, and the local newspapers; and to many meteorologists by special request.

The rainfall for the past year amounted to 31·7 ins., or 5·3 ins. in excess of the mean rainfall for the preceding thirty-one years.

The sudden and almost simultaneous changes in the direction and velocity of the wind, temperature, and barometer reading, and the commencement of the heavy rainfall, of the storm of the 24th of October are distinctly indicated in the automatic records; and show how difficult it must be to locally predict the occurrence of such a storm.—*Jan.* 17*th*, 1883.

CAMBRIDGE OBSERVATORY. Professor J. C. Adams, M.A., F.R.S.—The meteorological work has been carried on by Mr. Todd in precisely the same way as in past years. The 8 a.m. and 6 p.m. readings are forwarded every morning to the Meteorological Office, and a monthly report including observations made at 2 p.m. (with the exception of Sundays) is likewise forwarded.

No change has been made in the instruments:—the position of the sunshine recorder commands the path of the sun from rising to setting with the exception of a few days before and after the winter solstice, when the rising sun is hidden by trees for about a quarter of an hour.—*Jan.* 18*th*, 1883.

STONYHURST COLLEGE OBSERVATORY. Rev. S. J. Perry, M.A., F.R.S.—The meteorological work has been continued as usual during the past year. The observations connected with the International Polar Expedition were commenced on the 1st of August, in accordance with the instructions issued by the third International Conference, St. Petersburg, and will be continued until the 1st of September of the present year.

The systematic watching for Aurora in connection with the work of M. Sophus Tromholt, has been continued through the year.

Two barometers, thermometer, direct-vision spectroscope, sunshine recorder, and other instruments have been despatched by the director to the Observatory Real Collegio de Belen, Havana. A set of magnetic instruments is being prepared for the same observatory by Messrs. Elliott & Co.—*Jan.* 20*th*, 1883.

Notice of a remarkable Land Fog Bank, "The Larry," that occurred at Teignmouth on the Morning of Monday, the 9th of October, 1882.

By G. Wareing Ormerod, M.A., F.G.S., F.M.S.

[Read February 21st, 1883.]

"The Larry," a dense mass of rolling white land fog, though well-known at Teignmouth, does not occur there nearly as often as the semi-transparent sea fogs. This fog bank is confined to the bottom of the valley, differing therein from the sea fog, which rises above the top of the hills; it appears about daybreak, and has an undulating but well-defined upper edge, which leaves the higher part of the hills clear. It occurs occasionally, but very rarely, in the upper valley of the Teign as high as Christow, but does not reach up to the level of that village; it is also sometimes noticed in the valley of the Bovey Brook, a feeder of the Teign, as high as Yeo, between Lustleigh and Bovey Tracey; this fog, however, probably originates in the low ground of Bovey Heathfield and the marshy lands on the banks of the Teign by Newton Abbot, and from thence rolls down the more contracted valley to Teignmouth. At Teignmouth the fog first fills the lower part of the main valley and then rises to a height of rarely 90 ft., an elevation exceeded in the side valleys through which no current of air passes to carry the fog away; and it gradually diminishes as the sea is approached, when it soon disappears. Before noon the fog generally melts away or turns into a semi-transparent mist. The following description of the Southern side of the valley of the Teign is needful to show the extraordinary volume of fog bank, and the rapid changes that it underwent on the 9th of October, 1882. The estuary of the Teign runs from West to East. Teignmouth and the Haldon range are on the North, and Shaldon and the high ground of Stoke Common on the South. The headland of the Ness is the most Easterly point on the South side; a slight depression, estimated as about 140 ft. above sea-level at the lowest part, occurs between "The Ness" and the ground to the West, the land rising thence to form the high level of Stoke Common, which runs parallel with the valley of the Teign. To the West of this depression a short spur projects in a Northerly direction from the high ground, and at the extremity thereof there is a triangular plantation. The Eastern point of the base of this is 240 ft. above sea-level, or 15 ft. lower than the position at Woodway from whence the following observations were taken. To the West of this plantation a long spur runs in a North-westerly direction to the Teign near Ringmore, forming the Easterly side of a large irregular semicircular hollow, and the high ground to the West of this spur is the Eastern boundary of a long valley reaching from Stoke in Teignhead to the Teign.

On the morning of Monday, the 9th of October, the sky was bright and clear until about 5 a.m., when the fog began to appear. At 6.30 a.m. a dense bank of white fog drifted down the Teign. At 6.55 a.m. the top was marked by a well-defined line reaching nearly to the summit of the Ness, and to the lower part of the triangular plantation, but rose in a gentle curve

between those points, being considerably above the lowest part of the depression before mentioned. At 7.30 a.m. the main body of the fog bank reached half-way up the triangular plantation, or about 260 ft. above sea-level; the line at the top was broken occasionally by small patches of feathery mist; the semicircular valley was filled with thick fog. This showed over the summit of the short spur, but the upper fields on the Eastern side of the spur were visible. At 7.40 a.m. the fog bank had reached the top of the plantation, or about 280 ft. above sea-level. At 7.50 a.m. the fog bank had sunk below the plantation, which was left covered by transparent mist. At 8 a.m. the plantation and the whole of the spur up to the top of the hill were covered by fog. At 8.15 a.m. the plantation was clear, the fog having sunk about 40 ft., and the top of "The Ness" was visible. At 8.45 a.m. the fog had become thinner. At 9 a.m. the upper part of the fog bank had turned into thin mist, though it was thick below. At 10.45 a.m. "The Ness" was visible, and though the semicircular valley was still filled, the fog was gradually clearing. At noon the fog bank had changed into a semi-transparent mist occupying the whole of the valley of the estuary of the Teign.

The following is an abstract of the registers kept by Dr. Lake, in Bitton-street, Teignmouth, 70 ft., and that kept by myself above that town, at Woodway, 235 ft. above sea-level:—

Day.	October.	Dry Bulb.		Wet Bulb.		Humidity.		Max.		Min.		Cloud.		Wind.			
														Direction.		Force.	
		Lake.	Ormerod.	Lake.	Ormerod.	Lake.	Ormerod.	Lake.	Ormerod.	Lake.	Ormerod.	Lake.	Ormerod.	Lake.	Ormerod.	Lake.	Ormerod.
		°	°	°	°	o/o	o/o	°	°	°	°						
Sun.	8	55·5	57·4	51·3	53·8	79	77	60·9	64·2	50·6	48·6	5	5	NE	E	2	3
Mon.	9	46·5	51·0	46·4	50·8	99	98	57·2	60·0	43·2	45·8	10	10	NW	SW	1	1
Tues.	10	56·0	56·1	54·9	55·2	93	93	60·7	61·3	46·2	51·0	10	10	NW	S?	2	1

The direction of the wind is taken by Dr. Lake from a vane, and by myself from the clouds passing over my house which faces the South. On the 10th it was so very light that the direction was doubtful.

The difference between the thermometers on the 9th shows the effect of the fog in the valley.

On Sunday, the 8th of October, there was a heavy storm of rain with lightning and thunder at 8 a.m., but it soon passed, and the day was fine until evening, when heavy rain fell from 9.15 to 10.5 p.m. The night of Sunday and the early morning of Monday were fair, with clear starlight until a little after 5 a.m. when the fog bank above described began to appear. On Tuesday a thin sea fog reached to the hill tops, and in the evening rain fell heavily. As these thick fogs are not often experienced, and an opportunity occurred of noting the particulars of one more extensive than usual, it was considered advisable to record the above observations.

APPENDIX.

Date.	Mists seen in a Southerly direction from Woodway at 8 a.m.	Wind.	Cloud.	Min. Temp. Woodway.	Min. Temp. Bitton.	Humidity. Woodway.	Humidity. Bitton.
1882.							
Oct.							
25	Low fleecy mist on river; cleared 9.30 a.m.	NW	bc p	38·4	39·2	93	87
26	Ditto up to above Dunmore, 150 ft.; 5 a.m. divided into lines, and turned into general mist at 9 a.m.	SW	bc p	38·4	33·3	92	95
30	Slight thin mist on water	NW	c	41·0	41·2	96	91
31	Ditto	NW	bc	42·0	43·3	92	92
Nov.							
7	Slight thin mist on water	W	c	41·6	43·4	94	93
12	Very slight sea mist	E	c	38·1	36·9	85	80
13	Ditto	NE	c	39·0	40·4	90	83
14	Ditto	NE	bc	35·2	37·1	83	70
15	Ditto	NW	bc	32·1	32·4	84	86
21	Slight general sea mist to above Stoke Common, above 500 ft.	NW	bc	37·4	39·7	80	78
25	Thin mist to above Stoke Common	W	bc	42·0	43·2	85	85
30	Thin mist on water	N	bc	38·0	39·2	82	76
Dec.							
2	Mist; Babbacombe not visible	SE	cr	36·0	37·3	95	94
3	Thin mist on water	NW	bc	38·0	38·4	97	93
6	Thin general mist; thicker on water	NE	bc	30·8	32·3	87	73
9	Thin mist on river about 80 ft. high	NW	bc	29·8	30·5	86	87
10	Very thin mist	NW	bc	26·5	25·6	87	84
11	Thin mist, about 250 ft.	NW	bc	24·8	22·2	91	88
13	Very thick mist; outline of Ness and Stoke Common scarcely visible. Not Babbacombe	N	o	36·1	35·3	100	98
14	Mist; Babbacombe not visible	E	bc	38·0	37·2	98	91
15	Mist; Babbacombe not visible	NE	do	36·0	38·6	100	94
16	Thin mist	SE	cr	42·6	43·8	93	84
17	Thin mist; Babbacombe not visible	SW	bc	45·0	46·1	100	93
18	Thin mist; clouds formed on top of Stoke Common	SE	cr	46·0	47·0	100	94
19	Thick mist; Babbacombe not visible	NE	o	45·4	46·3	100	97
20	Thick mist in valley; 175 ft.	SW	do	38·6	40·0	100	97
21	Thin mist	NW	c pp	44·5	44·2	86	83
22	Thick mist on water above fleecy mist, 280 ft.	W	c	38·9	40·8	97	89
27	Mist	W	cd	50·1	51·6	98	85
28	Mist	W	cd	51·0	52·0	98	89
29	Thick mist; Babbacombe not visible	W	cd	50·4	51·7	97	91
30	Mist; Babbacombe not visible	SW	cr	49·1	50·7	100	90
31	Thick grey mist; outline of Ness and Stoke Common indistinct; Babbacombe not visible	SE	d	49·0	50·5	100	94
1883.							
Jan.							
1	Thick mist; Babbacombe not visible	E	cd	49·2	50·6	99	93
2	Thin mist	W	bc p	44·8	46·8	89	77
3	Thin mist on river	NW	bc	42·4	43·7	91	79
5	Mist; Babbacombe not visible	S	cr	41·0	40·1	96	90
7	Thick mist; Ness and Stoke Common indistinct; Babbacombe not visible	N	bc	33·1	32·0	97	97
8	Thin mist	E	oc	32·8	35·0	90	83
9	Thin mist	E	oc	34·4	36·3	86	81
10	Thin mist	SE	oc	33·5	35·0	96	..

APPENDIX—*Continued.*

Date.	Mists seen in a Southerly direction from Woodway at 8 a.m.	Wind.	Cloud.	Min. Temp.		Humidity.	
				Woodway.	Bitton.	Woodway.	Bitton.
1883. Jan.				°	°		
11	Thick mist; Babbacombe not visible	SE	bc p	46·0	47·0	100	94
12	Thick mist; Ness and Stoke indistinct; Babbacombe not visible	NE	o	41·0	42·3	95	89
13	Very thin mist	SE	cp	41·0	42·4	92	89
14	Medium mist; Ness and Stoke indistinct; Babbacombe not visible	E	o	41·0	42·6	96	89
15	Rather thick mist on water, and up to Dunmore, 133 ft.; Ness and Stoke clear; Babbacombe not visible	SW	bc	38·6	37·8	95	94
16	Low thin mist on water	SE	bc	33·1	31·0	92	95
17	Transparent mist; Babbacombe not visible	SW	bc	37·2	35·2	97	91
18	Medium mist; Babbacombe not visible ..	SW	cr	49·0	50·1	100	93
19	White fog; trees at Barn Park not visible, and trees at Gate to Woodway indistinct	SW	cp	41·8	42·3	100	93
20	Thin mist on water; Babbacombe indistinct	SE	cd	48·1	49·2	100	93
22	Medium mist to hill tops; Babbacombe indistinct	E	bc	40·6	41·7	91	83
23	Ditto ditto	SE	c	38·2	40·0	87	81
24	Thin mist to hill tops	SW	c	37·6	39·2	95	85
25	Thin mist on river	W	bc	36·6	38·0	79	75
26	General very thin mist.....	NW	cp	36·8	38·9	72	69
27	Medium mist; Babbacombe very indistinct	W	bc p	35·5	35·2	84	80
28	Very thin mist	NW	bc	36·0	38·0	86	81
29	Slight mist or rain	SW	o rr	41·9	..	86	91

The fishermen consider that the appearance of "The Larry" indicates a change of wind and weather, and that it will be cold. I do not think that this opinion is altogether correct.

SUPPLEMENTARY NOTES ON THE MISTS IN THE ESTUARY OF THE TEIGN, DEVONSHIRE. By G. WAREING ORMEROD.

OBSERVATIONS have been taken daily at 8 a.m. from Woodway in a Southerly direction, over the Estuary of the river Teign and Babbacombe Bay, from the 25th of October 1882 to the close of January 1883, an interval of 99 days, as to the mist in that district. During this time the opposite hills on Stoke Common, distant two miles, have been visible on 98 days, and Babbacombe cliffs distant five miles, on 81 days. On the 19th of January, 1883, the trees at Barn Park, distant about 850 yds. to the South of Woodway, were not visible, and those at Woodway gate were indistinct. The following were the points observed :—

Base of Dunmore House ..... Distant one mile and a quarter. Height 133 ft.
Summit of Ness Point ..... ,, one mile and a quarter. ,, 175 ft.

Eastern Angle of Triangular Wood..	Distant, one mile and a third.	Height 240 ft.
Base of Tower half-way up Wood ..	,, one mile and a half.	,, 280 ft.
Summit of Stoke Common	,, two miles.	About 500 ft.
Babbacombe (Mr. Glyde's)	,, five miles and a half.	Height 294 ft.

The appendix (p. 112) contains entries of the above mentioned observations of mist, and in addition those of the wind, cloud, minimum temperature, and humidity at Woodway, and the minimum temperature and humidity taken by Dr. Lake at Bitton. Although occasionally it is noticed that the temperature is lower at Bitton than at Woodway during dense mist, no practical general deductions have as yet been arrived at; but as the observations are continued daily, it is hoped that some light may ultimately be thrown by them on the meteorology of the district.

DISCUSSION.

Mr. SCOTT said that the photographs of the fog taken by Mr. Ormerod appeared to him to resemble the pictures given by Mr. G. Harvey, F.R.S. in the *Encyclopædia Metropolitana* of a fog at the entrance to Plymouth Harbour. Mr. Harvey gave no particular name to this fog, but his description of its formation much resembled the account given by Mr. Ormerod of the formation of the "Larry;" and the localities were not very distant from each other.

Mr. EATON thought that the value of the communication would have been enhanced if the author had given the temperature of the water of the Teign in addition to the minimum temperatures at Woodway and Bitton. How much the temperature of rivers and lakes, in relation to that of the incumbent air, influenced the formation of fogs over them, had been shown by Sir Humphrey Davy, Bart., V.P.R.I., in a communication to the Royal Society in 1819, entitled "Some observations on the formation of Mists in particular situations."

Mr. WHIPPLE said that the photographs represented nothing more than what was often seen at the Kew Observatory. From the roof of the Observatory he had frequently noticed that the upper surface of some fogs was sharply defined, the lower half of the trees round about being invisible while the tops could be clearly seen. Such fogs as these could of course only occur in calm weather. The observations at the Pagoda gave many instances of such fogs.

Professor ARCHIBALD considered that there were two sorts of fogs, one occurring when the water was cooler than the land, and the other when the land was cooler than the water. The "Larry" appeared to be of the latter sort, and was apparently caused by the cold air descending from the slopes of the neighbouring hills, and impinging upon the warmer and more humid air overlying the river.

Dr. MARCET inquired whether in such fogs as those described by Mr. Whipple the air was saturated with moisture.

Mr. WHIPPLE replied that the dry and wet bulb thermometers then read alike. He also remarked that at the seaside he had seen fog rolling over cliffs into valleys, and a magnificent sight it was.

Dr. TRIPE had seen instances of similar fogs to that described by Mr. Ormerod when staying at Tunbridge Wells, and in Switzerland.

Mr. SYMONS remarked that this fog covered a large area, the valley of the Teign being about two miles wide at Teignmouth. The observations made by Mr. Ormerod might be of great use in discussing the subject of fogs, as the height of this fog, the breadth of the Teign valley, and the distance the fog extended up the valley were known, and so its dimensions could be found; and in addition to these particulars, the temperature and other observations were given. When staying at Crowborough Beacon, at an elevation of 800 ft., in the vicinity of Tunbridge Wells, on looking out of his bedroom-window one morning he was surprised to find all the country enveloped in fog, and he could not even see the gravel paths in the garden round the house, while Beachy Head, and the Devil's Dyke, each about 25 miles distant, were clearly visible. He thought it

was a pity that observations of the visibility of distant hills should have been so greatly neglected, and referred to the observations on this subject made by Mr. Cruickshank in the valley of the Dee. He also referred to a suggestion which had been made some years ago, to set up poles painted with different colours at certain intervals at the lighthouses in the United Kingdom for the purpose of making observations as to the density and height of fogs.

Mr. DYASON inquired whether any reason could be given to account for the rising *en masse* of fogs 2,000 or 3,000 ft. thick; a phenomenon very common in Switzerland.

BAROMETRICAL DEPRESSIONS BETWEEN THE AZORES AND THE CONTINENT OF EUROPE.

By Captain J. C. De BRITO CAPELLO, Hon. Mem. M.S.

[Read February 21st, 1883.]

THE depressions which form the subject of this short inquiry present a few interesting features as to the variation in their rate of movement, and the change of form of the isobars during their transition. The depressions which cross over the Azores, or slightly to the North of these islands, are less frequent than those passing in higher latitudes; there are times, however, when the high atmospheric pressure usually met with in the region of the Azores is displaced towards the North, and under this circumstance depressions are observed in these Islands. The month of January, 1881, afforded an instance of this displacement of the maximum atmospheric pressure from its ordinary position. At all times of the year depressions in the neighbourhood of the Azores generally move towards the East or East-north-east, reaching the coast of Portugal, the Bay of Biscay, or the British Channel, and nearly all these phenomena could be foretold on the Continent by means of a telegraphic cable.

A depression between the 7th and the 12th of May, 1878, was remarkable from the alteration it underwent during transition as to its area, direction, and rate of progress. On the 7th of that month the isobars indicated a depression between the Azores and the North coast of Portugal, leaving a band of relatively high pressures from North to South, nearly in the middle of the Peninsula. Some rain in the centre of Portugal with the wind moderately strong marked the arrival of the depression. Next day (8th) the atmospheric condition varied but little; a movement of the depression towards the East occurred, however, and there was a continuance of strong wind and rain principally in the North of Portugal. The depression had assumed an elliptic form, its major axis being directed towards East-north-east. On the 9th the depression had undergone a considerable change, or possibly a new depression from the West interfered with the former, increasing thereby its area of action, and changing the direction of the major axis towards North-north-east. The isobar of 751 mm. passed through Ponta Delgada and Valencia, where the wind was strong from the East. From the 9th to the 12th, the depression moved very slowly towards the North-north-east with an increasing gradient. This depression seems to have been diverted from its original course, and its rate of progress retarded by high atmospheric pressure

over the Peninsula and France. Although the fall of the barometer in the Azores on the 8th was hardly 8 mm., the isobars, from observation on these islands, manifest the presence of a depression to the West of the Peninsula; the existence of this depression might have been made known with advantage in England and France, had the telegraphic cable, destined to connect the Azores with the Continent, been laid.

The depression of the 20th to the 25th of November, 1878, was as remarkable for the slowness of its movement as for its elongated form, these characters being apparently due in the main to high atmospheric pressure on the Continent. On the 18th an anticyclone reached the Irish coast, extending East and East-north-east. On the 19th and 20th a depression North of the Azores was travelling slowly towards the East, and its area was extending in the direction from South-west to North-east, so that it arrived on the 24th on the Southern coast of Ireland and England, in a much weakened condition. On the 21st the depression was experienced at the Azores, although the fall of the barometer was not great; at Ponta Delgada it reached 6 mm. and at Angra and Funchal 4 mm. This depression also appears to have spent its energy in overcoming the high pressure over the Peninsula, from the fact that on the coast of Portugal the wind was very high from between South-east and South-west in the night of the 22nd and morning of the 23rd. Torrents of rain fell at Lisbon, Ponto, Guarda and Montalegre. At Funchal rain commenced falling on the morning of the 22nd. The isobars, although only approximately correct from lack of observations at sea, show clearly enough the position and form of the depression. From the direction pursued by this depression, and from its change of form it did not reach the mouth of the British Channel until four days after having passed through the region of the Azores. The history of this depression exhibits one of the longest intervals between the occurrence of such a phenomenon at the Azores and its arrival in the British Channel.

A great number of depressions were observed at the Azores during January 1881. That between the 15th and 20th of that month ranks amongst those which a telegraphic cable would have been useful in announcing.

This depression, which occupied only a small area, progressed very rapidly. On the 15th and 16th there were no signs in the Channel or in England of any distant depression; but on the former day the direction of the wind in the Azores at 9 o'clock showed the approach of a depression on the West of these Islands. In the night of the 15th to the 16th this reached the Azores, and moved so rapidly towards East-north-east, that at 8 p.m. at Ponta Delgada the wind had become North-north-east, increasing in strength and blowing a gale at 9 p.m. On the 17th, at 9 a.m., the centre of the depression was North-west of Corunna, having progressed very rapidly since the day before, and the depression was approaching the British Channel; the centre, preserving the same direction, entered the mouth of the Channel on the 18th at 9 a.m. On the 19th at the same hour it occupied nearly the same position as on the previous day; but between the 19th and 20th, it crossed rapidly over Holland, and arrived on the 20th close to Berlin.

On the 24th of the same month, at 9 a.m., an area of high pressure covered the North of France and Germany, but a depression with slight gradients lay between the Peninsula and the Azores, with its centre close to the coast of Portugal. The gradient between Angra and Ponta Delgada, and the direction of the wind at 9 a.m. on these Islands, indicated a new depression in the North-north-west or North-west. Next day, at 9 a.m., the barometer had fallen 16 or 17 mm. at the two stations in the Azores, and there was a tempest from the West at Ponta Delgada; the gradient continued at 5 mm., and there was evidently a persistence of the depression in the North-west. The first depression reached the Bay of Biscay, while still of slight dimensions, but the wind was rather strong from East in the Scilly Isles. On the 26th the extensive depression to the North-west of the Azores had progressed towards North-north-east, becoming incorporated with the first. In the British Channel the wind was strong from East-south-east at the Scilly Islands. On the 27th the centre seems to have pursued a more Northerly direction; and on the 28th a depression of slight depth and small area was detached from the former and followed the line of the British Channel, touching the North Coast of France. The main depression, however, continued its progress towards the North-north-east, and the barometer at Valencia was lower than on the day before. This illustrates the incorporation of two depressions following each other, and affords an instance of the detaching of a depression of small area moving in a lateral direction.

DISCUSSION.

Professor ARCHIBALD exhibited a diagram which he had plotted out from the figures given by Captain Hoffmeyer, showing the mean tracks of certain groups of storms which crossed the Atlantic in 1873-4. From the tracks of storms as there laid down, it appeared that one-half of the storms which passed over the Azores affected the weather in the British Islands. The diagram also showed that storms seemed to start within a very small compass near Newfoundland, and gradually spread out in crossing the Atlantic. With respect to Captain Capello's Paper, Professor Archibald said that the facts seemed to accentuate what had so often been urged, viz. the desirability of obtaining as much telegraphic communication as possible. It would probably help weather forecasting as well as the science generally if telegraphic communication could be opened with Iceland, the Azores, and (as the diagram showed) even Greenland.

Captain TOYNBEE observed that Captain Hoffmeyer's Paper, "Etude sur les Tempêtes de l'Atlantique Septentrional et Projet d'un Service Télégraphique International relatif à cet Océan," seemed to show that telegrams from the Azores would be very useful aids towards forecasting the weather of the North Atlantic and of Western Europe. He hoped that the daily charts of the North Atlantic now being prepared by the Meteorological Office would supply data for forming a decided opinion on the subject, for as the ships wrecked in a day probably cost much more than the expense of such a cable for a year, it was only requisite to convince the world that many such wrecks could be prevented, and money would be forthcoming for laying down telegraph cables to those islands.

Mr. SCOTT said that the laying of cables to Iceland and to the Azores had been projected for several years, and in the latter case several concessions had been granted by the Portuguese Government, but so far as he knew no money had yet been contributed for laying either cable. As regarded that to Iceland, the proposal at present before the public, which had been made by some Danish capitalists, contemplated the raising of the necessary funds by *pro ratâ* contri-

butions from the countries which would be most interested in the receipt of weather intelligence, the *quota* for this country being stated at upwards of £3,000 a year, which would be a severe tax on the resources of the Meteorological Office. It was interesting to see that Captain Capello had traced some depressions from the Azores to the British Islands, for the only previous statement as to the Azores storms with which Mr. Scott was acquainted, was that made in the *Nautical Magazine*, 1842, p. 145, by Mr. Hunt, Her Majesty's Consul in those islands, to the effect that the storms felt there travelled to the South-east.

Mr. C. HARDING considered that the weather-systems which advance on the British Islands from the Atlantic must in their passage exert some influence on the barometer at the Azores. He had examined all the tracks of storm-centres shown in the United States *Monthly Weather Review* for the year 1879, and out of a total of ninety-two distinct storm-centres observed in the North Atlantic during the year, there were fifty-nine which left American waters, and of these thirty-seven (63 per cent.) crossed the Atlantic to European coasts.

Mr. WHIPPLE thought that a clear distinction should be made between the terms storms and areas of low pressure, the popular idea of a "storm" being very different to what was meant when that word was used by meteorologists; it was desirable that the terms should not be confused. He had lately been studying the United States weather maps for the first three months of 1881, and from these it appeared that the depressions originated in a lower latitude than was shown by Professor Archibald's diagram, most of them commencing below latitude 40°. They then sailed across the Atlantic in a curved direction, passing the neighbourhood of the Azores, and ultimately reached these latitudes. It was, however, in his opinion, a mistake to advocate the laying of a cable between the Azores and England for purely meteorological purposes.

Mr. C. HARDING observed, respecting Mr. Whipple's remarks, that a depression was not always a storm, but a storm was invariably a depression or very intimately connected with one.

WEATHER FORECASTS AND STORM WARNINGS ON THE COAST OF SOUTH AFRICA.

By Captain CAMPBELL M. W. HEPWORTH, F.M.S.

[Read February 21st, 1883.]

HAVING had considerable opportunity of observing the meteorological phenomena of the South and of a portion of the South-east coast of Africa, I venture to offer some remarks upon their variations, and upon the barometric and thermometric oscillations accruing therefrom.

Perhaps, there are few localities where meteorological changes occur more rapidly than on this coast, and I have reason to believe that on no other can they be predicted with greater accuracy.

In this brief sketch I propose to follow the coast-line from Natal to Table Bay, centering my observations in the principal ports. The wet season in Natal is from October to February, when the winds are usually Westerly and light; but rain occurs occasionally at all times of the year. After a continuance of rain, the barometer rising steadily all the time, a fresh Easterly gale follows, the weather clears, and atmospheric pressure commences to diminish, the wind blowing hardest after the mercury in the barometer has fallen about 0·8 in.

May, June, and July are the finest months on the coast of Natal, when the barometer is steady at about 30·10 ins.; a light wind coming in from the seaward during the day, and a breeze blowing from off the land during the

night: but strong gales occur both from the Eastward and Westward even during these months. August, September, and October are the most boisterous months of the year, when the range of the barometer is great, and the gales alternate between the Eastward and the Westward. For instance, the barometer stands say at 30·60 ins. at 8 a.m., and the thermometer at 70° Fahrenheit in the shade; the sky overhead would be cloudless but for the cirro-cumulus from the South-east. A peculiar haze hangs over the horizon; a bank of cirro-stratus lies towards the South-east: it is calm. Towards noon the temperature increases considerably, and atmospheric pressure continues to decrease. At noon, or sometimes with the first of the flood-tide, a breeze springs up from about East, and soon freshens to a moderate gale. The barometer falls rapidly, and as the afternoon advances the wind veers to the Northward of East.

These gales from the Eastward blow from about South-east, fifty or a hundred miles to seaward, but are deflected on arriving near the coast, and take the direction of the coast line *i.e.* East-north-east, or still more Northerly, when they blow home; and it is the swell set up by the wind at South-east so far seaward which, catching the vessels at anchor in Natal Roads on the starboard bow, heading to wind and sea East-north-east, causes them to ride so uneasily, and when they part, to cant towards shore.

The wind then blows down the coast about East-north-east, and towards evening has increased to a strong gale. A long heavy swell sets in from about South-east; but the wind usually moderates towards sunset or shortly after, the barometer ceasing to fall. At sunrise next morning, or with the first of the flood-tide, the breeze again freshens, the barometric pressure again diminishing, and the temperature increasing rapidly. By noon, the gale will probably have reached its height, or more certainly when the barometer has fallen to about 30·00 ins. A thin line of cirro-stratus stretches along the western horizon; a high breaking cross sea rolls into the roadstead, the heaviest rollers coming from about East-south-east; and now cirrus appears in the sky from the North-west, and the cirro-stratus deepens to the Westward. The gale continues to blow steadily until about three hours before sunset, or when the mercury has fallen to about 29·70 ins. to 29·80 ins., and a bank of clouds rises to the North-west, throwing out long streaks of cirrus across the sky. The wind becomes puffy, and the temperature rapidly decreases.

Directly the mercury ceases to fall, the wind moderates, often suddenly, and the sea surface has the appearance of boiling water.

The wind will probably die away altogether after sunset, and a heavy dew fall; but the change of wind, in many cases, comes directly after the Easterly gale has dropped, the reading of the barometer often being as low as 29·60 ins. before the breeze takes off. It is when the barometer begins to rise that the change comes, usually with the turn of tide; but sometimes immediately after the Easterly wind has dropped, particularly in October, November, and December, when the wind blows suddenly from the

North-west with great violence, bringing with it a heavy driving rain. The wind generally continues to freshen as the pressure rises, after shifting to the South-west in a rain squall, and blowing itself out with a rising barometer: but the hardest gales occur when the wind veers slowly to West or West-south-west, with a drizzling rain, and the mercury oscillates between 30·00 ins. and 30·10 ins., the thick drizzling rain obscuring the land at a distance of less than two miles.

These South-west gales extend, as a rule, from Cape St. Francis to Mozambique, and last for forty-eight hours or more; but it has been found that the wind has been usually more moderate and the weather clearer fifty to a hundred miles seaward.

Directly the mercury rises decidedly the weather moderates, and these gales are often followed by fine settled weather: they mostly occur in April and October. A high hollow sea gets up; for the Easterly gale which is sure to have preceded it will have increased the velocity of the current, which often runs at the rate of three or four knots an hour to the South-westward even within four or five miles of the shore, and thus the South-west wind driving the water against the stream raises a mountainous sea. One of the most dangerous seas I have encountered was off Gordon Bay, midway between Natal Bluff and the Buffalo River, during a furious South-west gale. The great range and the frequent oscillations of the barometer on the South-east coast of Africa are well known, and on no portion of the coast are they more striking than on the coast of Natal.

With reference to the typical Easterly gale, which I have attempted to describe, although there may be many variations, not only in regard to the time of its commencement but also as to its duration and force, its salient points are always the same.

Rain precedes it, and a high barometer: a South-east swell, and a peculiar haze over the horizon, mark its coming; it commences directly the mercury falls; it is at its height when that has fallen 0·8 in. or 0·4 in.; a lower temperature and a bank of clouds to the North-westward mark its decline, and it is always followed by a Westerly gale.

The strength of the current which flows between the Tugela River and Cape Padrone may be judged roughly by the temperature of the water, as an increase in the velocity of the current gives rise to an increase of temperature, but the normal temperature must be known. Now the current between Natal Bluff and the Aliwal Shoal within two or three miles of the shore is usually weak, and the temperature of the surface water may be taken roughly as a standard.

This must not, however, be depended upon for judging the velocity of the current when it traverses the outflow of the Buffalo River.

The weather off the Buffalo River presents a marked difference to that of any other part of the coast; and this is probably due to the difference in the temperature and specific gravity of the water. Here, when the mercury commences to rise on the wind shifting to the Westward, usually about sunset, the crisis is accompanied by lightning, thunder and heavy rain. If the wind

shift suddenly in a squall to the South-west—the barometric pressure increasing rapidly—a moderate to fresh gale may be expected with fine weather, which will continue until the mercury attains 30·40 ins. or higher. If the barometer remain low and steady, a strong gale may be expected from West-north-west, which will probably continue for several days; but if the wind veers slowly to South-west, atmospheric pressure increasing very slowly, and a drizzling rain sets in, a fierce gale and mountainous sea may be looked for. These much dreaded South-west gales occur often after unsettled weather in June, July and August, preceded by a moderate to fresh Easterly breezes and a gradually diminishing pressure.

The wind begins to blow hard from West, and veers slowly until the mercury attains about 30·00 ins.; the sky becomes leaden-looking, and a thick drizzling rain sets in. The barometer oscillates between 30·00 ins. and 30·10 ins., and the thermometer is considerably below the average. These gales blow with great violence, and have been the cause of much disaster to shipping, at different times, in East London Roads.

During the summer the strongest winds are from the Eastward.

Between Cape Corrientes, and probably still further North, and Cape Padrone, the wind almost always follows the coast line, when it blows home, and the prevailing winds during the months of May, June, July and August are Westerly, although, in all cases, the Westerly winds are preceded by a high but diminishing pressure, and an Easterly wind: the prevailing winds during summer blow along the coast from the Eastward, preceded by a Westerly wind and a rising barometer. It may be inferred from the direction of the swell which almost always precedes a breeze, that the wind, whether from Eastward or Westward, has a more Southerly direction out at sea when it blows home, and that it is deflected on arriving at the coast.

From Cape Padrone, following the coast line to the Southward, comes a change in the order of things: the capes, bays, and deep indentations in the land being probably the reason for the wind retaining its original direction, as it appears to do. During the summer, namely, from October to April, Easterly winds prevail between the Kowri river and Table Bay, and their direction is South-east when they blow home.

Atmospheric pressure is usually high all through the summer, and has less range than during winter; but an unusually high barometer precedes a stiff South-easter, and the wind blows with a bright sky; the mercury falling; and, as with the East-north-east wind, between Cape Corrientes and Cape Padrone, haze hangs over the horizon, and cirrus appears in the sky.

Should the reading of the barometer be about 30·50 ins. and cirrus appear, a South-easter will set in before twenty-four hours have elapsed; or, if the hills to the Northward of Port Elizabeth be obscured by haze, a gale from South-east may be expected. I remember a stiff South-easter in October when the reading of the barometer was 29·80 ins., and the only indication of its approach was the haze over these mountains. These South-east gales are dangerous to shipping in Algoa Bay and Mossel

Bay, and send in a heavy breaking sea. The breeze commences, generally, at noon, when the pressure begins to decrease; it seldom lasts so long as forty-eight hours. The wind drops at sunset, but, if the barometer has not fallen rapidly, it will probably freshen again at sunrise, and blow harder on the second day. When the mercury has fallen 0·4 in. or 0·5 in. or more, a bank of clouds forms to the North-west, and the wind dies away towards sunset; and next morning, if not before, there is a fresh breeze from the North-west.

During winter, the wind rarely blows strongly from the South-east into Algoa Bay or Mossel Bay; but a high diminishing pressure indicates a North-easterly or Northerly wind. This is a land wind. It becomes hot and damp as it freshens, and a bank of clouds rises to the Westward; the mercury falls rapidly; rain follows, and generally a brisk North-west gale, with the barometer low; the wind afterwards veers to West-south-west and South-west, blowing hardest at West-south-west, with a rising barometer. Many of the Westerly gales, which blow with such violence off the land into the Bay, are local, a change of wind and weather often occurring off Cape St. Francis.

Between Cape Corrientes and Cape St. Francis the coast-line generally affects the course of an isobar, which during the summer extends South-east in Algoa Bay and Mossel Bay when it is East-north-east in Natal Roads.

A "black South-easter" blows occasionally in winter, but more frequently during spring, in October and November. It may be expected when the barometer—with the wind at about East-north-east—ceases to fall, and the wind backs. These gales do not last long, but are very violent: they are generally succeeded by fog, and are accompanied by thick drenching rain, which obscures everything beyond a distance of somewhat less than two miles.

There is a peculiarity about the rainfall on the South Coast of Africa; it is in almost all cases attended with a rising barometer. As I have before stated, the Easterly winds, excepting the black South-easter, blow with a bright sky and diminishing atmospheric pressure, the weather getting hazy as the barometer falls, and the wind dying away when the mercury has fallen about 0·4 in. or more, when the Western sky will have become packed. The cirrus cloud deepens and overcasts the sky. The wind at sunset, or at sunrise next morning, comes squally from the North-west, with rain. Now, from the end of September to the beginning of November, an almost tropical downfall of rain may be experienced for a day or two; atmospheric pressure increasing all the time, until the reading of the barometer is as high as 30·50 ins.; the rain then becomes intermittent and the weather soon after clears. When barometric pressure begins to fall again the wind comes from the South-east; it may remain steady from this quarter perhaps for forty-eight hours, but rarely longer. From Cape Corrientes to Table Bay the bright, warm genial weather is in all cases with an Easterly wind, and diminishing pressure, or with the high atmospheric pressure and calm which precede it.

It is generally believed that a rising barometer indicates an Easterly wind, both in Port Elizabeth and Natal; and so, to this extent, it does, in that an Easterly wind will not commence to blow until the mercury has reached a certain height; but I know of no instance of an Easterly wind setting in while the mercury was rising.

Following the coast-line from Cape St. Francis to the Southward and Westward, little change will be found in the weather indications; but a marked change in the direction of the wind, and therefore also in the weather, is experienced off Cape L'Agulhas.

Though a South-east wind may prevail from Cape St. Francis to the Southward and Westward, in seven cases out of ten it will shift to the Northward off Cape L'Agulhas. South-east gales often blow hard also between L'Agulhas and Cape Point, but off L'Agulhas they generally moderate.

The violent Westerly gales of winter, which raise a high sea, frequently extend from Table Bay—speaking, of course, of the coast line—to Cape Corrientes, and probably still further to the North-eastward; but a "whole" Westerly gale, from Cape Point, will often be partially cut off at L'Agulhas. During summer South-east gales prevail between L'Agulhas and Cape Point, but they usually fall away off Cape Point or Slang Kopp, close in with the land.

In Table Bay the ordinary indications of a South-easter are well marked —a high atmospheric pressure, a clear sky, and the cloud cap known as the "Table-cloth" on the top of Table mountain; but it may not be generally known that, during the hardest South-easters, the Blue Berg and Hottentot Holland mountains, to the Eastward of Table Bay, are obscured by mist, and that often after the "cloth" has disappeared the gale continues until these mountain ranges are clear. In autumn, during South-east gales, the top of Table mountain is quite clear. Such a gale is called a "blind South-easter," but the Blue Berg and Hottentot Holland mountains are clothed in mist twenty-four hours or more before the breeze springs up, by which sign it may thus be confidently foretold. Moreover, the wind does not die away until these mountains are clear. The "blind South-easter" is often very violent. North-west gales seldom continue long between Cape Corrientes and Table Bay during the summer. Both in summer and winter their advent is indicated by a low, steady barometer, a clear atmosphere, a low temperature, and generally a bank of clouds to the Westward. The wind begins to blow after a slight increase of atmospheric pressure, and as it shifts to South-west through West the barometer continues to rise, the force of the wind being greatest from about West-south-west with the barometer at 30·00 ins. and the temperature low. Some of the hardest gales from the Westward succeed moderate Easterly winds, when atmospheric pressure has ceased to increase, the barometer being at about 30·00 ins., with the wind at West.

The heavy North-west gales, which cause so much damage to shipping in Table Bay, are preceded by atmospheric pressure decreasing slowly, and the temperature increasing to an unusual height, thirty-six hours or more before their advent. Cirrus appears in the North-west, the air becomes damp

towards evening, and, during the night or in the early morning, Table mountain and the adjacent high land become enveloped with clouds. The barometer is low. The wind rises suddenly from North-west, accompanied by heavy rain squalls, and it veers to South-west through West; though in winter especially its direction often remains constant from West-north-west for forty-eight hours with continuous rain. The wind drops and the weather clears soon after the wind gets to the Southward of West; but when it shifts quickly from North-west to South-west in a squall, a strong gale from that quarter, with a rising barometer, may be expected, the wind moderating when the reading of the barometer attains 30·30 ins. Such gales are mostly followed by fine settled weather; but when their direction veers slowly, the wind frequently backs to the North-west, and blows with greater violence. A wind between North and North-west in the vicinity of the Cape of Good Hope, with the barometer steady at about 30·00 ins. or lower, brings rainy, misty weather and fog.

During October and November fierce North-west gales, lasting for days, are occasionally experienced between Cape St. Francis and Cape L'Agulhas, the barometer keeping as low as 29·60 ins., and the temperature being about 60°.

DISCUSSION.

Capt. MACLEAR said that the paper was a description of in-shore weather, and that the experience of a vessel rounding the Cape, though only a short distance off the coast, might be very different. It served to show the very local character of the weather that prevailed in each bay of the South coast of Africa, though the whole system of gales moved from Westward to Eastward, and reached each point in succession. The "black South-easter" was quite different from the ordinary South-easter, which was but a continuation of the Trade wind intensified, and brought clear, dry weather. The "black South-easter" seemed to be part of an Atlantic Westerly gale, and brought moisture; its true direction on striking the coast would probably be South-west, though it reached Table Bay round Simon's Berg and Devil's Berg from the South-east.

Capt. TOYNBEE remarked that the gales experienced near the South-east coast of Africa, which changed from a North-easterly to a South-westerly direction, to which Capt. Hepworth alluded, had been dealt with in the "*Report on the Gales experienced in the Ocean District adjacent to the Cape of Good Hope*," lately published by the Meteorological Office. In that work they came under the head of "exceptional gales." In the same work it had been shown that "black South-easters" were generally preceded by Northerly winds, whereas the "fine-weather South-easter" was an intensifying of the ordinary South-east Trade of the South Atlantic from local causes.

Mr. C. HARDING referred to the discussion of the gales in the Cape of Good Hope district recently published by the Meteorological Office, and said that Captain Hepworth's observations were a strong confirmation of those results.

Note on the Reduction of Barometric Readings to the Gravity of Latitude 45°, and its Effect on Secular Gradients and the Calculated Height of the Neutral Plane of Pressure in the Tropics.

By Professor E. Douglas Archibald, M.A., F.M.S.

[Read February 21st, 1883.]

Some few months, ago when reading Part I. of Mr. Ferrel's *Meteorological Researches*, published in 1877, I noticed that the barometric means which he had amassed for the delineation of a new set of isobaric charts of the Northern hemisphere were all reduced to the gravity of latitude 45°. The formula which he used to effect this reduction was substantially

$$p = p_1 (1 + \cdot00284 \cos 2\theta) \quad \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

where θ is the co-latitude, and p, p_1, the reduced and observed barometric pressures respectively.

This equation is evidently deduced from the consideration that the effect on the barometric column of the change of latitude is the inverse of that on gravity; the observed column being too high near the equator, and too low near the poles.

The amount is not very large perhaps when considered in relation to the so-called non-periodic fluctuations of the barometer recorded in middle and high latitudes, or to the large variations sometimes witnessed in a tropical cyclone, and may reasonably be neglected when drawing daily weather charts, especially where these embrace only a small portion of the earth's surface in the direction of latitude. When, however, the question relates to mean isobaric charts representing large districts for periods of months and years, this correction can no longer be dispensed with, since its omission, especially owing to the fact of its always acting in the same direction, may sensibly affect conclusions regarding the actual distribution and gradient of pressure. Thus, if Mr. Buchan's isobaric charts be examined, it will be found that the extreme amplitude of the barometric pressure represented on them (*i.e.* the difference between the pressures of the most pronounced anticyclone and the deepest cyclone) amounts to about 0·6 in. on the chart, representing the mean of the year, to about 1 in. in that for January, and 0·8 in. in that for July.

Now the total correction from the equator to the poles, according to the formula just quoted, for a pressure of 760 mm. (= 29·922 ins.) would be 0·168 in., and even according to a more correct formula, which will be given further on, only slightly less, namely 0·158 in., or about one quarter of the extreme gradient in Buchan's annual chart, and about three-twentieths and three-sixteenths of those in the charts for January and July respectively.

Practically, the isobars are not affected to quite the extent indicated by these quantities, since the existing charts do not extend to the pole. That

they are materially altered, however, may be proved by comparing the gradients on the charts drawn by Ferrel with those of Buchan.

Thus the differences between the nearly permanent area of high pressure in latitude 30° in the North Atlantic, and the corresponding area of low pressure surrounding Iceland, is 0·8 in. in January and 0·6 in. on the mean of the year in Buchan's charts, while in Ferrel's they are reduced to 0·54 in. and 0·39 in. respectively.

The omission to use the gravity factor, not only affects secular isobaric charts, but also all calculations in which extensive baric gradients are employed, such as those by which Blanford and others have obtained the approximate height of the neutral plane of pressure, in other words, the top limit of the Monsoon current, in India.

The average pressures and corresponding heights of the 'neutral plane' between Ceylon and Sikkim and Ceylon and Dehra Dun, as computed from the observed mean barometric pressures at sea-level and at an elevation of 7,000 ft. at certain representative stations are thus given by Messrs. Blanford[1] and Hill[2]:—

Mean Pressure and Height of Neutral Plane.

Months.	Ceylon and Sikkim.		Ceylon and Dehra Dun.	
January.....	24·20 ins.	5,900 ft.....	25·54 ins.	4,480 ft.
July	20·12 ins.	10,900 ft.....	16·92 ins.	15,730 ft.

When the correction for gravity is introduced into the gradients at sea-level and at 7,000 feet (in the latter case proportionally to the reduced pressure) the pressures and corresponding heights become changed into the following:—

Months.	Ceylon and Sikkim.		Ceylon and Dehra Dun.	
January.....	23·33 ins.	6,989 ft.....	24·60 ins.	5,567 ft.
July	20·68 ins.	10,134 ft.....	17·65 ins.	14,588 ft.

The mean heights of the neutral plane are thus about 1,000 ft. higher in winter and 800 ft. lower in summer between Ceylon and Sikkim, and 1,100 ft. and 1,200 ft. at the corresponding seasons between Ceylon and Dehra Dun, the difference in latitude being slightly greater in the latter case.

These differences are, I think, large enough to merit consideration, and might, especially since the position of the neutral plane is affected oppositely at the contrasted seasons, introduce considerable modifications into conclusions regarding the depth of the Monsoon current over India at different seasons.

Mr. Ferrel, at p. 38, gives a table for the reduction of a barometric pressure of 760 mm. to the gravity of lat. 45°, based on the formula already noticed.

Before using this table I thought it worth while to compare the formula employed, with Clairault's as ordinarily given, and on doing so, noticed a con-

[1] *Indian Meteorologist's Vade-Mecum*, p. 79.

[2] *Indian Meteorological Memoirs*, Vol. I., No. XII. p. 404.

siderable discrepancy in the value of the coefficient as given by Ferrel, amounting to about +·00089. Nothing was said in Mr. Ferrel's work as to the source of this coefficient, so in my doubt I wrote to Professor Stokes, Sec.R.S. In reply he said, "I take for granted that Ferrel does not question Clairault's formula, but makes some discussion of pendulum observations or of measures of arcs or of both, from which he gets his coefficient. I think his coefficient must be too large. It would give an ellipticity of less than 1 by 330." This confirmed my suspicions that the coefficient in question was erroneous, or at least founded on somewhat antiquated data. I therefore communicated direct with Mr. Ferrel, who courteously gave me the following explanation of the source of his erroneous coefficient, and its correction in his latest work on Hypsometry, which has not yet been published. He says, "The coefficient ·00284 was copied from La Place without any research on the subject. I was not then aware that there was any material difference between it and more recent values, and supposed it was at least accurate enough for my purpose at that time. When I came to the third part of my *Meteorological Researches* (not yet printed) on Barometric Hypsometry, I looked into the matter more carefully, and found that subsequent values of that coefficient differed very materially from La Place's, and so I have changed it to ·002606.

"I copy the following from the MS. of Part III. of my *Researches*:—

"'In the recent determination of the figure of the earth by Col. Clarke from pendulum observations we have

$$g = g^\circ (1 + \cdot 005226 \sin^2 \lambda) = g^\circ (1 + \cdot 002613 - \cdot 002613 \cos 2\lambda)$$

whence—

$$g = 1 \cdot 002613\, g^\circ \left(1 - \cdot \frac{002613}{1 \cdot 002613} \cos 2\lambda\right)$$
$$= g_1 (1 - \cdot 002606 \cos 2\lambda)$$

This numerical coefficient of cos 2λ has been adopted here instead of the one in (3) Part. I. copied from La Place, which is considerably greater. g° above is the value of g at the equator, and g_1 on the parallel of 45°,—all at sea-level. λ is the latitude.'"

Clairault's formula gives ·00255 as the value of the coefficient, and the difference between this and that derived from Col. Clarke's pendulum observations is so small, that the latter may be safely taken as a basis for future calctlations.

Using this value, I have calculated the following table of reductions to be applied to a barometric pressure of 30 ins. at sea-level, in order to reduce it to the gravity of latitude 45° for every fifth degree of latitude, which I trust may be of use to those who desire to employ the correction.

TABLE.

Latitude.	Reduction.	Latitude.	Reduction.
°	In.	°	In.
0	—0·078	45	0·0
5	— ·076	50	+ ·013
10	— ·073	55	+ ·026

TABLE.—*Continued.*

Latitude.	Reduction.	Latitude.	Reduction.
°	In.	°	In.
15	— ·067	60	+ ·039
20	— ·059	65	+ ·050
25	— ·050	70	+ ·059
30	— ·039	75	+ ·067
35	— ·026	80	+ ·073
40	— ·013	85	+ ·076

I think a very cursory glance at the above table will show that the corrections there exhibited are on a scale commensurate with those so sedulously applied to barometric readings in order to reduce them to sea-level, or zero temperature, and that to omit the former when the latter are applied, would be, to use a familiar metaphor, straining at a gnat and swallowing a camel.

DISCUSSION.

Mr. C. HARDING remarked that Guyot's tables contained in a very complete manner the corrections for gravity. For strictly scientific investigations this correction was no doubt necessary, but he disregarded its use in ordinary meteorological reductions.

Prof. ARCHIBALD in reply said that he preferred Colonel Clarke's figures to Guyot's, because they were the result of more recent investigations. The fact of there being a correction for the change of gravity with the latitude was of course well known to most meteorologists. He thought, however, all were hardly aware of the magnitude of the error introduced by its omission, both in drawing isobars over a large extent of surface and in calculating the height of the neutral plane of pressure (as in India). It was while working at this latter subject, that he found the correction necessary, and thought it might be advisable to communicate a note on the point to the Society.

PROCEEDINGS AT THE MEETINGS OF THE SOCIETY.

JANUARY 17th, 1883.

Annual General Meeting.

JOHN KNOX LAUGHTON, M.A., F.R.A.S., F.R.G.S., President, in the Chair.

Mr. T. W. BAKER and Mr. R. INWARDS were appointed Scrutineers of the Ballot for Officers and Council.

Dr. TRIPE read the Report of Council and the Financial Statement for the past year. (p. 83.)

It was proposed by the PRESIDENT, seconded by Dr. TRIPE, and resolved:—"That the Report of Council be received and adopted, and printed in the *Quarterly Journal* of the Society."

It was proposed by Mr. ELLIS, seconded by Mr. BREWIN, and resolved:—"That the best thanks of the Meteorological Society be communicated to the Council of the Institution of Civil Engineers for having granted the Society free permission to hold its Meetings in the rooms of the Institution."

It was proposed by Capt. TOYNBEE, seconded by Mr. ROSTRON, and resolved:—"That the thanks of the Society be given to the Officers and other members of the Council for their services during the year."

It was proposed by Dr. WILLIAMS, seconded by Mr. C. HARDING, and resolved:—"That the thanks of the Society be giving to the Standing Committees and to the Auditors, and that the Committees be requested to continue their duties till the next Council Meeting."

The PRESIDENT then delivered his Address. (p. 71.)

It was proposed by Dr. MANN, seconded by Mr. SCOTT, and resolved:—"That the thanks of the Society be given to the President for the ability and courtesy displayed by him in the chair during the year, and for his Address, and that he be requested to allow it to be printed in the *Quarterly Journal* of the Society."

The Scrutineers declared the following gentlemen to be Officers and Council for the ensuing year:—

President.

JOHN KNOX LAUGHTON, M.A., F.R.A.S., F.R.G.S.

Vice-Presidents.

EDMUND DOUGLAS ARCHIBALD, M.A.
ROGERS FIELD, B.A., M.Inst.C.E.
BALDWIN LATHAM, M.Inst.C.E., F.G.S.
WILLIAM MARCET, M.D., F.R.S., F.C.S.

Treasurer.

HENRY PERIGAL, F.R.A.S.

Trustees.

HON. FRANCIS ALBERT ROLLO RUSSELL, M.A.
STEPHEN WILLIAM SILVER, F.R.G.S.

Secretaries.

GEORGE JAMES SYMONS, F.R.S.
JOHN WILLIAM TRIPE, M.D., M.R.C.P.ED.

Foreign Secretary.

ROBERT HENRY SCOTT, M.A., F.R.S., F.G.S.

Council.

HON. RALPH ABERCROMBY.
WILLIAM MORRIS BEAUFORT, F.R.A.S., F.R.G.S.
JOHN SANFORD DYASON, F.R.G.S.
HENRY STORKS EATON, M.A.
WILLIAM ELLIS, F.R.A.S.
JOSEPH HENRY GILBERT, PH.D., F.R.S., F.C.S.
CHARLES HARDING.
ROBERT JOHN LECKY, F.R.A.S.
CAPT. JOHN PEARSE MACLEAR, R.N.
EDWARD MAWLEY, F.R.H.S.
GEORGE MATHEWS WHIPPLE, B.Sc., F.R.A.S.
CHARLES THEODORE WILLIAMS, M.A., M.D., F.R.C.P.

FEBRUARY 21st, 1883.

Ordinary Meeting.

JOHN KNOX LAUGHTON, M.A., F.R.A.S., F.R.G.S., President, in the Chair.

REV. WILLIAM RANKEN CALVERT ADAMSON, Ashtead Rectory, Epsom ;
WINTOUR FREDERICK GWINNELL, 43 Barnsdale Road, Paddington, W. ;
CHARLES SMITH HUDSON, The Cams, Freemantle, Southampton ;
THOMAS MANN, Roseneath House, Winchmore Hill ;
ROGER POCKLINGTON-COLTMAN, Hagnaby Priory, Spilsby ;
FREDERICK GWILYM TREHARNE, 14 London Street, E.C. ; and
WILLIAM TYSON, 365 New Road, Halliwell, Bolton,
were balloted for and duly elected Fellows of the Society.

The following Papers were read, viz. :—

"NOTE ON A REMARKABLE LAND FOG BANK, 'THE LARRY,' THAT OCCURRED AT TEIGNMOUTH ON THE MORNING OF THE 9TH OF OCTOBER, 1882." By G. WAREING ORMEROD, M.A., F.G.S., F.M.S. (p. 110.)

"BAROMETRIC DEPRESSIONS BETWEEN THE AZORES AND THE CONTINENT OF EUROPE." By CAPT. J. C. DE BRITO CAPELLO, HON. MEM. M.S. (p. 115.)

"WEATHER FORECASTS AND STORM WARNINGS ON THE COAST OF SOUTH AFRICA." By CAPT. CAMPBELL M. HEPWORTH, F.M.S. (p. 118.)

"NOTE ON THE REDUCTION OF BAROMETRIC READINGS TO THE GRAVITY OF LATITUDE 45°, AND ITS EFFECTS ON SECULAR GRADIENTS AND THE CALCULATED HEIGHT OF THE NEUTRAL PLANE OF PRESSURE IN THE TROPICS." By PROF. E. DOUGLAS ARCHIBALD, M.A., F.M.S. (p. 125.)

CORRESPONDENCE AND NOTES.

METEOROLOGY OF THE OCEAN DISTRICT ADJACENT TO THE CAPE OF GOOD HOPE.

THE Meteorological Office has recently issued two publications on the Meteorology of the Ocean District adjacent to the Cape of Good Hope.

The first of these publications[1] contains a series of meteorological charts, and is accompanied by a volume of explanatory "Remarks." These Remarks give an account of the observations employed, and of the mode in which they have been treated; a description of the Charts; and a statement of some of the chief results obtained.

The number of sets of observations employed is about 147,000. The observations extend over a period of 24 years, from 1855 to 1878 inclusively, and are in all equivalent to the observations of 24,500 days.

Some important departures have been taken from the ordinary methods adopted in the mode of treating the observations: in the first place, the observations have been weighted, so as to avoid an error which commonly exists from the fact that head winds materially delay the ship, and in consequence too many observations are recorded. As a ready, though only approximate method, the plan was adopted of admitting no more than a single observation from the same ship on the same day, and in the same one-degree square. Secondly, the principle of dividing the district into homogeneous areas was adopted instead of the method hitherto followed of obtaining mean results for spaces of uniform size.

The series of Charts consists of—

A. Twenty-four large monthly charts, one pair for each month, arranged face

[1] Meteorological Charts for the Ocean District adjacent to the Cape of Good Hope. (Between lat. 30° and 50° S. and long. 10° and 40° E.) Published by the authority of the Meteorological Council. Official No. 43. 4to. 1882.

to face. These contain the original observations, in as much detail as is practicable, and also generalised results. The Chart to the left, when the book is opened, refers to Wind, Air-temperature, and Barometric Pressure; that to the right refers to Ocean Currents and Sea-surface Temperature.

B. Two index Charts for the whole year, each giving on a small scale the generalised results only.

C. Quarterly Charts of the Specific Gravity of sea water, of the distribution of floating Ice, and of the times taken by outward bound ships to traverse the district.

The following are some of the chief results arrived at:—

Winds.—The prevalent wind-systems appear to be six in number.

No. 1. A West wind that prevails over the whole of the lower half of the district, and part of the upper half.

No. 2. The South-east Trade wind of the Atlantic.

No. 3. A contingent to the Atlantic Trade winds, from the western part of the district. It becomes a South-east wind just before its confluence with the South-east Trades of the Atlantic Ocean.

No. 4. Another contingent to the South-east Trades of the Atlantic, which has arrived from the East Coast of Africa, sweeping round the Cape. This is probably a Southern portion of the South-east Trades of the Indian Ocean, diverted into a North-easterly wind, when it enters the Chart, by its proximity to the land of Africa and to the Western edge of the area of high pressure in the Eastern part of the district.

No. 5. An air current in exactly the opposite direction to No. 4. It is weak in summer and strong in winter, and in this respect contrasts with No. 4.

No. 6. A Northerly current over the Eastern part of the district.

Gales are most frequent in July, least so in February. The areas of their greatest frequency approximate roughly, at least in the winter months, to those of wide range in Sea-surface Temperature.

Currents.—The Ocean Currents in the district referred to may be resolved into two primary and three secondary ones.

The Primary Currents are:—

No. 1. The narrow "Agulhas Current" running strongly to the South-west off the South-eastern coast of South Africa and along the edge of the well-known Agulhas Bank, which stretches to the South of the Cape l'Agulhas. It is warmer by some 8° than the neighbouring water in the same latitude, its temperature in February being as high as 70° in the 39th parallel of latitude.

No. 2. A current running North-eastwards, and covering the whole of the Southern portion of the Chart. In S. lat. 46° to 50°, throughout the year its temperature is as low as 40°, being nearly 10° lower than the surface temperature of the sea in the same latitudes in the Pacific Ocean.

These two currents, travelling the one to the South-west and the other to the North-east, come into direct opposition in and about S. lat. 40°, and especially in the neighbourhood of E. long. 20°. There they check, and intermingle with, one another; facts which are respectively shown by the crowded isotherms, and by the wide range of sea-surface temperature.

From the region in which the two Primary Currents meet, the Secondary Currents (3) and (4) proceed.

No. 3 is a cool current running North-westwards along the western coast of South Africa.

No. 4 is a warm current running Eastwards a little to the North of S. lat. 40°, and to the East of E. long. 20°.

No. 5 is a back drift of the Agulhas current running North and North-eastwards between it and the coast.

The discussion also gives information respecting Ice and Passages, as well as copious Weather Tables.

The second publication[1] is a Report on the Gales experienced in the Ocean District adjacent to the Cape of Good Hope.

[1] Report of the Gales experienced in the Ocean District adjacent to the Cape of Good Hope. (Between lat. 30° and 50° S, and long. 10° and 40° E.) By Captain H. Toynbee, F.R.A.S. Published by the Authority of the Meteorological Council. Official No. 44. 4to. 1882.

This discussion is from the same collection of observations as that which formed the material for the work which has just been described. The typical months of January and July are alone treated in detail, the results for the other months being summarised at the end of the work.

The method followed in the discussion of the gales is different from that hitherto adopted. Usually it has been thought sufficient to give the relative frequency of gales in comparison with other winds, but this mode of treatment does not afford any idea of the kind of gale from which such winds resulted, or to the duration of the various gales experienced. In the present discussion all the phenomena of wind belonging to an area of low barometer have been kept entire and unbroken so far as the observations of a single ship experiencing such a gale will allow, and further the winds preceding the gale, from the time of the commencement of a falling barometer, as well as the winds following the gale, till the barometer has regained a maximum height, have been discussed with the gale, as forming parts of the wind systems to which the gales belong.

The following remarks show the directions under which the gales have been classed, and the part of the district where the special kind of gale chiefly prevails :—

1. North-westerly, or those which commence from North or North-west, even though several veer to West or South-west.

These are the ordinary gales of the South Temperate zone, and correspond to the South-westerly gales veering to West or North-west of the Northern Hemisphere.

About one-third of the gales met with in the district belong to this class ; an average of forty-two per cent. being experienced on the outward, and twenty-seven per cent. on the homeward passage.

The North-westerly gales met with on the outward passage are pretty uniformly distributed in longitude, whilst those met with on the homeward route are chiefly confined to the Western half of the district.

2. South-westerly, or those which commence and continue to blow from the South-westward.

These gales sometimes commence from West and veer to the South-westward. About one-third of the gales met with in the district belong to the South-west type ; there being an average of twenty-nine per cent. met with on the outward, and thirty-six per cent. on the homeward passage. The South-west gales met with on the outward passage are pretty uniformly distributed in longitude, though they have a tendency to be more frequent and violent to the Southward of the Agulhas Bank than elsewhere. Those encountered on the homeward route are chiefly experienced near the Eastern edge of the Agulhas Bank and near the South-east coast of Africa.

3. North-easterly, or those which commence and continue to blow from the North-eastward. North-easterly gales are frequently followed by a sudden shift to South-westerly gales ; such instances have been classed with the "Exceptional Gales." These gales form about 6½ per cent. of all gales. They are more frequent on the homeward than on the outward route. North-east gales are generally experienced in the Eastern half of the district. Those met with on the homeward route are nearly always experienced near the South-east coast of Africa.

4. South-easterly, or those which commence and continue to blow from the South-eastward. These gales are divided into two classes, viz. :—(*a.*) Those which are preceded by Northerly to North-westerly winds and a falling barometer, the wind generally changing to the South-eastward at the time of lowest barometric pressure ; (*b.*) Those which are preceded by South-easterly winds. These have been subdivided into 'fine weather' and 'bad weather' gales. South-east gales form about ten per cent. of all gales. They are most abundant on the homeward passage. The South-easterly gales met with on the outward passage are generally experienced in the eastern half of the district ; whilst those met with on the homeward passage seem to depend on their character for their position. For instance, the fine-weather South-easterly gales which are preceded by Southerly winds are generally felt near Cape of Good Hope, whilst South-easterly gales, preceded by Northerly winds changing to South-east about the time of lowest barometric pressure, are generally met with in the Eastern half of the district.

5. Exceptional, or those which cannot be classed under any of the above

headings. They have been grouped according to their resemblance to certain types, but are dealt with individually. About 16¾ per cent. of all gales were classed as 'exceptional,' and the proportion was much the same on the outward as on the homeward route. They, in common with nearly all other kinds of gales, were much more abundant in winter than in summer. Exceptional gales are generally more frequent on the Eastern than on the Western side of the district, especially those experienced on the homeward route. In the winter they extend further to the Westward, and at that season several were met with near the Cape of Good Hope.

The most dangerous type of Exceptional gale is that which changes quickly from North-east to North-west or South-west; gales of this type are frequently encountered, but more especially near the South-east coast of Africa.

C. H.

RECENT PUBLICATIONS.

AN ACCOUNT OF EXPERIMENTS TO TEST THE ACCURACY OF REGISTERING ANEMOMETERS. By H. SAXON SNELL, F.R.I.B.A., F.M.S. 8vo. 15 pp.

This account was originally published in the *Engineer* of 23rd June, 1882. The author has made a number of experiments with Biram's Anemometers, and the results of his inquiry prove that the registering dials, as corrected by the instrument makers' formula, were perfectly unreliable; and he therefore assumes that the deductions hitherto arrived at and published by the numerous eminent experimenters using this description of instrument for testing the velocities of air in ventilating shafts and mines are similarly unreliable.

ANALES DE LA OFICINA METEOROLÓGICA ARGENTINA POR SU DIRECTOR BENJAMIN A. GOULD. Tomo III. 4to. 507 pp. 1882.

This volume contains the report of the Director for the year 1880, and discussions on the climate of certain places in the Argentine Republic, together with daily observations chiefly extending from 1874 to 1880. There is also added an Isothermal map, showing the distribution of mean annual temperature over the Southern portion of South America.

ANNALES DU BUREAU CENTRAL MÉTÉOROLOGIQUE DE FRANCE, PUBLIÉES PAR E. MASCART, DIRECTEUR. Année 1877; Année 1879, Parts II., III., and IV.; Année 1880, Parts I., III., and IV. 4to.

The volumes for 1877 (279 pp.), 1879, part 3 (303 pp.) and 1880, part 3 (304 pp.), are devoted to Rainfall, and give the rainfall over France for each day of the year. In 1877 the number of stations was 981; in 1879, 1113; and in 1880, 1219. Maps are added showing the distribution of rainfall for each quarter and for the year.

Part II., 1879 (302 pp.), contains the results from 107 second order stations in France and Algeria, as well as a paper by A. Angot, entitled Revue Climatologique mensuelle pour la France et les contrées voisines pendant l'année 1879, which is accompanied by forty maps, showing the monthly and yearly distribution of pressure, wind, temperature and rainfall.

Part IV., 1879, contains:—Théorie de la circulation atmosphérique, par M. de Tastes (18 pp. and 5 plates).—Etude de la circulation atmosphérique sur les continents, par L. Teisserenc de Bort (42 pp. and 33 plates). This is an investigation into the general characteristics of atmospheric circulation over the Spanish Peninsula, and the relations existing between temperature, pressure and wind in each month of the year are shown by beautifully executed charts.—Nouvelles recherches sur le climat du Sénégal, par Dr. A. Borius, d'après les observations météorologiques faites pendant cinq ans (1874-1878) (31 pp.).

Part I., 1880, contains:—Résumé des orages en France et d'état de l'atmosphère pendant l'année 1879, par E. Fron (21 pp. and 28 plates).—Rapport sur les orages de l'année 1879 dans le sud-ouest de la France, par M. Lespiault (6 pp.).—Rapport sur les orages de l'année 1879 dans le département d'Indre-et-Loire, par A. de Tastes (7 pp.).—Température du sol et de l'air observées au

Muséum d'Histoire Naturelle pendant l'année 1880, par MM. E. et H. Becquerel (10 pp.).—Formes des nuages dans l'Europe septentrionale, représentées et décrites par P. Weilbach (30 pp. and 4 plates). This is an account of the forms of cloud in Northern Europe, and contains a summary of the history of cloud nomenclature and classification. It is illustrated by sixteen clearly executed representations of various forms of clouds.—Etudes sur le Climat de Paris, par E. Renou (50 pp. and 4 plates). The author has undertaken a discussion of the climate of Paris, based on documents which go back to the end of the seventeenth century, and continue, in various forms, up to the present time. In this Paper he has taken up the subject of atmospheric pressure, and gives the mean pressure of each month at Paris during the 122 years, 1757-1878.—Marche diurne de la Température, de la Pression Barométrique, et de l'Humidité sous le climat de Paris, par A. Angot (23 pp. and 4 plates). This is an investigation into the diurnal range of the temperature, pressure and humidity of the air during the seven years, 1873-1879.—Etudes sur le psychromètre, suivies de nouvelles tables psychrométriques par A. Angot (22 pp. and 1 plate).

Part IV., 1880 (oblong folio, 120 pp. and 14 plates), comprises a work by Lieut. L. Brault on the Winds of the North Atlantic, compiled entirely from French documents. Part I. contains in tables 235,000 observations of the direction, and as many of the force of the wind, while Part 2 shows by charts the principal differences which exist between the law of the winds of summer and of winter, as regards both direction and intensity.

ANNALI DELLA METEOROLOGIA. Parte I. 1881. 4to. 1882.

Contains two papers by Prof. D. Ragona, viz.:—Sul periodo diurno della elettricità atmosferica e della corrente tellurica ascendente (8 pp.), and Sulle ore delle massime e minime velocità assolute del vento in Modena (3 pp.).

ANNUAIRE DE LA SOCIÉTÉ MÉTÉOROLOGIQUE DE FRANCE. 30me Année. 1882, Avril-Juin. 4to. 1883.

Contains:—Rapport sur les Stations météorologiques du Service des Eaux de Versailles, présenté à la commission météorologique de Seine-et-Oise, par E. Richard (4 pp.).—Note sur une nouvelle Girouette de M. E. Richard (2 pp.).—L'Anémomètre multiplicateur de M. E. Bourdon père, par L. Descroix (6 pp.).—Sur la situation atmosphérique en Janvier 1882, et en l'hiver de 1879-80. Théorie des aires de dépression non tourbillonnaires et des aires de dépression, par M. Cousté (17 pp.).—Nouvelle note sur le climat du Sénégal, par Dr. Borius (6 pp.).—Manuel de la prévision du temps à Bar-le-Duc (parts 3 and 4), (38 pp.).—Projet d'un Baranémographe, par M. Cousté (9 pp.).—Abaissement probable des eaux courantes dans le bassin de la Seine pendant l'été et l'automne de 1882, par G. Lemoine et A. de Préaudeau (3 pp.).

I. ASSEMBLEA GENERALE DELL' ASSOCIAZIONE METEOROLOGICA ITALIANA NELLA CITTÀ DI NAPOLI dal 25 Septembre al 1 Ottobre 1882. 8vo. 65 pp.

This is a report of the proceedings at the general Assembly of the Italian Meteorological Association held at Naples on the above dates.

ASSOCIATION FRANÇAISE POUR L'AVANCEMENT DES SCIENCES. CONGRÈS D'ALGER. 1881. 8vo. 1882.

Contains the following papers by Padre F. Denza:—Variation de la déclinaison magnétique déduite des observations régulières faites à Moncalieri (3 pp.).—Organisation de l'Association Météorologique Italienne (2 pp.).—Sur les lois générales des variations de l'électricité atmosphérique déduites des observations régulières faites à l'observatoire de Moncalieri (3 pp.).—Sur les lois de la variation diurne de l'électricité atmosphérique à Moncalieri (5 pp.).—Détermination des valeurs absolues du magnétisme terrestre en Italie (4 pp.).

CIEL ET TERRE—REVUE POPULAIRE D'ASTRONOMIE ET DE MÉTÉOROLOGIE. Vol. III.-Vol. IV. February-April 1883. 8vo.

Contains:—Observations de Nuages, par G. Tempel (4 pp.).—Spectres des Eclairs et des Aurores Boréales, par C. Fievez (3 pp.).—Les périodes de l'Aurore Boréale, par Dr. F. Terby (10 pp.).—Notes pour servir à l'histoire du Baromètre,

par J. Palmarts (5 pp.).—A propos des Sinistres du 6 Mars 1883 (7 pp.).—Histoire de l'hygromètre, par G. J. Symons (translation) (13 pp.).

HANDLEDNING VID METEOROLOGISKA OBSERVATIONERS ANSTÄLLANDE AF E. EDLUND. Andra Upplagan med författarens tillstand omarbetad och tillökad af H. E. HAMBERG. 70 pp. 8vo. 1882.

This is a new edition of the Instructions for Meteorological Observers in Sweden.

MICHIGAN AND ITS RESOURCES. Compiled under the authority of the State, by F. MORLEY, Commissioner of Immigration. Second edition. 1882, 8vo. 166 pp.

This work contains sketches of the growth of the State, its industries, agricultural productions, institutions and means of transportation, descriptions of its soil, climate, timber, financial condition, and the situation of its unoccupied lands, &c. The climate of Michigan is colder on the average than that of European countries lying in the same latitude; the extremes of heat and cold are greater, the winters being colder and the summers hotter than corresponding seasons of European countries having the same mean annual temperature. The mean temperature of Lansing, the Capital of the State, is 46°·7, and the mean annual rainfall 31·31 ins.

PROCEEDINGS OF THE ROYAL SOCIETY. Vol. XXXV. No. 224, 1883. 8vo.

Contains:—Note on Terrestrial Radiation, by John Tyndall, F.R.S. (5 pp.) The author, since the beginning of November 1882, has continued to record from time to time on Hind Head, 900 ft. above sea-level, 3 miles from Haslemere, the temperature of the earth's surface as compared with that of the air above the surface. His object was to apply, if possible, the results which his experiments had established regarding the action of aqueous vapour upon radiant heat. The results show that with atmospheric conditions sensibly alike, the waste of heat from the earth varies from day to day, an effect due to the action of a body which escapes the sense of vision.

REPORT OF THE NEW YORK METEOROLOGICAL OBSERVATORY of the Department of Public Parks, Central Park, New York, for the Year ending December 31st, 1882. DANIEL DRAPER, Ph.D., Director. 4to.

In addition to the daily observations this contains a table, showing the monthly, quarterly and annual rainfall for forty-seven years, 1836-1882, in the vicinity of New York City. The sunshine records are taken by Draper's self-recording sun thermometer, which is illustrated and described. This instrument "not only gives the maximum temperature in Fahrenheit degrees, but also the number of hours of sunshine; and if any clouds or mists have passed between it and the sun, it gives their density in degrees of temperature."

SYMONS'S MONTHLY METEOROLOGICAL MAGAZINE. Vol. XVIII. NOS. CCV.-CCVII. February-April, 1883. 8vo.

Contains:—The recent floods in Western Europe (3 pp.).—Fog Gauges (6 pp.).—On Fog and Fog Signals, by Dr. J. H. Gladstone, F.R.S. (3 pp.).—Artificial Auroræ (4 pp.).—Measurement of Snow (2 pp.).—Scheme for the observation of the Upper Clouds (2 pp.).—Ball Lightning (2 pp.).

THE PRINCIPAL SOUTHERN AND SWISS HEALTH RESORTS, THEIR CLIMATE AND MEDICAL ASPECT. By WILLIAM MARCET, M.D., F.R.S. 408 pp. with 8 Plates. 8vo. 1883.

The author having spent several winter seasons at Nice and Cannes, engaged in medical practice, details the experience he had acquired of the influence of southern climates on invalids. The work is divided into fourteen chapters, and gives some interesting information to invalids seeking a winter health resort in the South, with notes on the climate of many places on the Mediterranean, as well as in Switzerland, Egypt, Madeira and Teneriffe. The meteorological chapters are:—III. On the Natural Laws of Climate; IV. Winds and Weather on the

Mediterranean; and V. The Climate and Winter of Cannes, and generally of the French and Italian Riviera, throughout the six months of the winter season.

THE SHIPWRECKED MARINER. Quarterly Maritime Magazine. Vol. XXIX. Nos. CXIII.-CXVI. 1882. Edited by W. R. BUCK. 8vo. 1883.

Among other matter this volume contains a series of articles on "Great Gales," by a Fellow of the Meteorological Society. After an elementary notice of the cause of storms, the author gives a record of all the great storms that he can find (80) in the old chronicles between B.C. 55 and A.D. 1702. Chapter IV. is devoted to an extended account of the storm of November 1703, which has been called "The Great Storm."

VERHANDLUNGEN DES VEREINS FÜR NATURWISSENSCHAFTLICHE UNTERHALTUNG ZU HAMBURG. Band V. Nos. 10-12. October-December, 1882. 8vo.

Contains:—Mittheilungen über einen Taifun bei Yokohama und Yeddo am 8 September, 1860, und einen vom 18-20 August, 1869, von. Capt. A. Schück (22 pp. and 2 plates).

ZEITSCHRIFT DER ÖSTERREICHISCHEN GESELLSCHAFT FÜR METEOROLOGIE. Redigirt von Dr. J. HANN. XVIII. Band. February-April, 1883. 8vo.

Contains:—Ueber die Blitzableiter, von H. L. F. Melsens (8 pp.).—Ueber die Entstehung der Wolkenstreifen, von Dr. W. Linss (17 pp.).—Erwiderung auf die Kritik meiner Messungen der Wolkenhöhe durch Herrn Jesse, von Dr. Vettin (3 pp.).—Projicirte Geschwindigkeit der Wolken und deren Bestimmung, von Dr. Vettin (5 pp.).—Die Entstehung der Cyklonen, von Dr. P. Andries (9 pp.).—Die physische Oceanographie der das Cap der guten Hoffnung umgebenden Meerestheile im südatlantischen und indischen Ocean, zwischen 30° und 50° S Br. und 10° bis 40° E. Lg. (5 pp.)

QUARTERLY JOURNAL

OF

THE METEOROLOGICAL SOCIETY.

VOL. IX. No. 47.

NOTES ON A MARCH TO THE HILLS OF BELOOCHISTAN IN NORTH WEST INDIA, IN THE MONTHS OF MAY TO AUGUST, 1859, WITH REMARKS ON THE SIMOOM, AND ON DUST STORMS.

By HENRY COOK, M.D., F.R.G.S., F.M.S.

[Read March 21st, 1883.]

THESE months may be considered as the Hot Season of the Plains, and the Summer of the Tableland of Beloochistan; but as I spent portions of this time successively at Bhag and Dahdur in the Plains, in the ascent of the Pass, and at Quetta, Mustoong, and Khelat in the Hill Country, it will perhaps be well to consider them separately, and to obtain some comparison of the climate of the various places visited.

Bhag is situated about 68° East long. and 29° North lat. and 650 ft. above the sea. It is the central and largest Town of this Province of Kutchee.

I was here during the first week in May, and therefore at the commencement of the hot weather; the thermometer gave the following results:—

	Dry bulb.	Wet bulb.
Mean of twenty-four hours	100°·5	76°·8
Minimum	69°·0	
Maximum	126°·0	

Difference between dry and wet bulbs, 33°·7.

The air was excessively dry, as evidenced by the difference between the dry and wet thermometers (frequently 35°), and by the fact that the dew-point was not attainable even at 5 a.m., although I reduced the temperature of the hygrometer 50° below that of the atmosphere. The nights were cool and pleasant.

The wind was generally Northerly, moderately cool, but occasionally accompanied with clouds of dust, when the temperature was considerably raised.

There is but little in the surrounding country to moderate the climate of

Bhag. Large tracts of desert, or Put, are varied here and there with strips of low jungle of Tamarisk, Kundo, Babaal, and Milkbush.

In the immediate vicinity there are fields and gardens irrigated from the river Narra. This during the year 1859 had a bund thrown across it to retain the water, which at certain seasons nearly floods the country, and at others entirely disappears.

Dahdur is situated about 67° 34′ East long. and 29° 28′ North lat. at a height of about 700 feet above the sea, and about thirty-five miles in a direct line North-west of Bhag. I remained here about three weeks, and found much, both in the climate and in the appearance of the surrounding country, to induce me to think more favourably of it than of Bhag, although the situation is confined.

	Dry bulb.	Wet bulb.
The mean temperature of twenty-four hours...	96°·3	71°·0
Minimum	64°·0	
Maximum	120°·0	

Difference between the dry and wet bulbs, 25°·3.

The air was excessively dry, as indeed it is throughout Kutchee and Upper Scinde. I tried repeatedly to obtain dew with the hygrometer, but without success, although the temperature was reduced by 54°. The dry and wet bulb thermometers stood respectively at 102° and 72°.

The skies were generally clear and bright with the exception of a bank of clouds which rested on or over the Eastern flank of the Halla range.

The wind was mostly Southerly with more or less Westing. It usually rose about 8 a.m. or 9 a.m., and blew until night. A hot wind frequently came up from the North-west in the evening, about two hours after sunset, lasting about an hour.

No rain fell during the three weeks.

The dew, if any, was very slight; none was ever observed.

Two furious but short dust storms occurred, preceded for a day or two by more or less dust in the atmosphere. This accumulated by degrees until the climax was reached, afterwards the air was perfectly clear.

There is a good deal of cultivation around Dahdur, large quantities of wheat are grown in the valley; also cotton, cucumbers, and melons.

The district is well supplied with water by the Bolan river, which, issuing from the mouth of the Pass of that name, is immediately divided into three principal streams. These are again and again subdivided, as required for irrigation. The water is pure and good; and the soil, when irrigated, fertile and easily worked.

Dahdur is much better provided with trees and gardens than Bhag, indeed there is a considerable amount of foliage surrounding the town and the adjacent villages.

At this time of year (May) the heat for the first three marches up the Bolan Pass is exceedingly great—Kundelami, immediately inside the mouth of the Pass, is considered deadly at times even by the natives. No great amelioration of the heat was experienced until a height of 5,500 feet was

reached. No dew was observed in the Pass, but on the Dasht-i-ke-dowlut there was a soaking dew.

At Sir-i-Balan (4,300 feet) I obtained the dew-point by means of snow and salt at 6.30 a.m. at a temperature of 45°, the thermometer standing at 87°.

Tableland of Beloochistan.—The summer of the Hill Country of Beloochistan includes the months of May, June, July, and a part or the whole of August; though the natives expect the weather to change soon after the fall of rain, which takes place about the end of July and beginning of August.

Compared with that of the plains the climate is delightful. The actual heat is greater than in England, especially the intensity of the sun's rays, but the weather is less variable. Fruits and crops, as a rule, ripen earlier, and are not exposed to the vicissitudes of the English climate.

The atmosphere is clear and pure, the air dry and bracing. The skies, usually bright and cloudless or faintly chequered with light masses of cumuli and cirri, want the deep blue of Southern climes, but have a beauty peculiarly their own.

The character of the climate, depending on the altitude, of course varies in different portions of the country. Khelat is the highest point (about 7,000 feet above sea level) and possesses the most agreeable temperature.

Quetta (5,900 feet) resembles it; while Mustoong, though but slightly lower (5,700 ft.), is considerably hotter, and so doubtless are the valleys to the Southward, which, descending by steppes to a level but little above that of the plains, lose more and more the characteristics above named until they reach Lus. Mustoong has been spoken of as the most eligible site for a sanitarium, but it is certainly considerably hotter than Khelat; the maximum temperature reaching 109°, whilst at the latter place the highest observed was 101°. From some cause also the heat often produced a drowsiness and langour not experienced at Khelat.

The following observations are for the months of June, July and August, 1859:—

	Dry bulb.	Wet bulb.
Mean maximum	94°·5	
Mean minimum	58°·3	
Mean between sunrise and sunset	76°·3	59°·3
Extreme maximum	103°·0	
Extreme minimum	48°·0	

At sunrise a gentle Southerly breeze prevailed, lasting till about 8 or 9 a.m., when a Westerly breeze set in; or the wind gradually veered from South to West, and towards evening ceased or further veered to the North for a short time.

Easterly winds were occasionally experienced, bringing up clouds from the South-east or East, and not unfrequently thunder and rain storms.

Furious storms of wind are not uncommon in the Hill Country. One occurred at Khelat in June, which uprooted trees and rifted the branches.

The sky was usually clear, almost always so at sunset. Cumuli formed during the heat of the day, gradually dissolving towards night; or changing

into masses of cumulo-stratus, passed into nimbi and ended in rain or thunder storms. A few cirri and cirro-cumuli formed before and during high winds.

Slight dew occurred in June, more towards the end of July, and heavy dews in the beginning of August, the nights usually being free from clouds.

The air, although not so dessicated as in Kutchee, is still exceedingly dry, the average difference between the dry and wet bulb thermometers being 17°·0 from sunrise to sunset, and at times reaching 36°.

The evening skies rarely present the red and yellow colours so common at sunset in England; but from their greater dryness, they preserve the grey and blue tints. A green tint is sometimes conspicuous.

In the summer months a storm of rain occurs occasionally, accompanied by lightning and thunder. About the middle or end of July a more steady and considerable fall is experienced, and continues at intervals throughout August and the following months. It is of great importance to the country. The amount of rain which falls at Khelat is much less than at Lus, Mekran, and the valleys of less altitude: as the position of Khelat is much higher than the usual level of rain-clouds, which seldom exceeds 4,500 ft.

Heavy storms among the hills swell the mountain streams into torrents, when the sky here may be free from cloud. The inhabitants consider such a fall of rain to presage the close of summer and the commencement of autumn. There is certainly a marked difference in the weather; the nights become cold and the air in the early mornings sharp and bracing, the sky is more screened by clouds, and the mean temperature between sunrise and sunset is reduced about 10°.

The rain appears to be connected with the South-west monsoon, being most abundant about its height; but the rain-bearing winds do not come up from the South-west, but, crossing the Halla Mountains, reach Khelat from the East.

The Southerly winds, saturated with moisture, sweep over the Southern part of Scinde and impinge on the mountain range running North by East, by which the moisture is condensed, forming the masses of cloud which during these months almost continuously hang over the Eastern flank of the range.

(Probably the return current of the Westerly wind, which blows so invariably over the mountain districts, may be the means by which the clouds are carried across the intervening space and thus reach Khelat from the East.)

Major Malcolm Green informs me that the same phenomenon exists in the Boogtee and Munnee Hills to the North of the desert of Shikarpoor. The skies of Scinde are generally cloudless, but the heated currents of air from the South on reaching the elevated land are gradually cooled and their vapours condensed. This occurs gradually. At Gundooce the sky is cloudy often for weeks together; further North and in the more elevated position of Dhera in the Boogtee Hills, slight rain occasionally falls; whilst at Kahun the fall of rain is heavy and continued.

In these mountain districts the fall of rain is often considerable in a short time; and the water drains off by a limited number of torrents, which

suddenly rise, rush for a time with great violence, and as suddenly cease. On the evening of the 24th of July during a heavy storm at Khelat, half an hour after its commencement a torrent of water rushed down the usually dry bed of the river some thirty yards broad and 2½ to 3 ft. deep; by the next morning the bed was again dry. The rain is almost invariably accompanied by thunderstorms.

Intimately connected with the subject of electricity are the dust storms so common in Scinde and Kutchee, and in a less marked form in the hill districts of Beloochistan. These may, I think, be considered under three heads, according to their intensity:—Atmospheric Dust, Dust Columns, and Dust Storms.

As to atmospheric dust, there are some days on which, however hard and violently the wind may blow, little or no dust accompanies it, whilst on others every little puff of air or current of wind raises up and carries with it clouds of dust. At these times the individual particles of sand appear to be in such an electrical condition that they are ever ready to repel each other, and are consequently disturbed from their position and carried up into the air with its slightest current.

To so great an extent does this sometimes exist that the atmosphere is filled with dust, and if a strong wind is blowing nothing is visible at the distance of a few yards, the sun at noon being obscured. The dust penetrates everywhere, and cannot be excluded from houses, boxes, and even watches, however carefully guarded.

The condition of atmosphere is evidently such that the phenomenon increases in intensity. There is a greater tendency for dust to rise, the wind is perhaps more liable to gusts and sudden increase in strength, until by degrees the climax is reached, when, after a certain time, usually about twenty-four hours, the atmosphere is cleared.

Dust columns doubtless originate under similar electrical conditions, though somewhat modified. On calm quiet days, when hardly a breath of air is stirring and the sun pours down his heating rays with full force, little eddies arise in the atmosphere near the surface of the ground; these increase in force and diameter, catching up and whirling round bits of stick, grass, dust, and lastly sand, until a column is formed of great height and considerable diameter, which usually, after remaining stationary for some time, sweeps away across country at great speed; ultimately it loses gradually the velocity of its circular movement and disappears.

In the valley of Mingochar, which is only a few miles in width, and surrounded by high hills, on a day when not a breath of air stirred, I counted upwards of twenty of these columns. They seldom changed their places, and when they did so moved but slowly across the level tract; they never interfered with each other, and appeared to have an entirely independent existence.

When this state of the atmosphere prevailed, other signs of an excess of electricity were evident. The hairs in the tails of horses repelled each other, until the appendage resembled a birch-broom or bottle-brush of large size,

At night, when flannel or other non-conducting substances were rubbed or touched, flashes of light were given off, and on removing the blankets from a bed broad bright flashes were emitted. It also became almost impossible to brush the head, from the hair being so greatly attracted as to follow the passage of the brush.

Dust columns are called shaitans or devils by the Beloochees, who have a superstitious feeling with regard to them. The usual course of rotation is from right to left, or from East round by North to West; but I believe that it may yet be demonstrated that the direction depends on the character of the electricity engaged. That it is totally unconnected with the general direction of the wind, and is dependent on atmospherical electricity, hardly admits of doubt. It may perhaps be ultimately referred to electro-magnetism, an hypothesis which has been supported by experiments on the rotation of horizontal currents.[1]

Sir Bartle Frere mentioned to me an incident which bears on the subject, and which I had an opportunity subsequently of verifying. He stated that an engineer officer had remarked more than once of the rise of the river Indus, and consequent flow of water through the canal which supplies the water for irrigation in Upper Scinde, that a huge dust column preceded the onward rolling wave for miles.

On the 18th of April, the Indus having risen sufficiently, the water flowed up the canal and reached Jacobabad about 5 p.m. Preceding it by about a quarter of an hour a vast pillar of dust moved slowly along and crossed the cantonment. The sky was dark and cloudy, thunder muttered in the distance, and a slight shower of rain fell. Distant lightning was observed all night. This was followed by an immediate and considerable fall in the temperature, and the weather, which before had been exceedingly sultry and oppressive, became pleasant and agreeable, and the nights as cool as they had been a month previously. In this case a decided electrical disturbance was apparent, excited probably by friction.

I have not had an opportunity of witnessing many well-marked dust storms, but I will describe one that took place at Jacobabad in April. The weather had been hot and oppressive, with little or no breeze and a tendency for dust to accumulate in the atmosphere. On the evening of the storm heavy clouds gathered and covered the sky: about 9 p.m. the sky had cleared somewhat, and the moon shone; a breeze sprang up from the West, which increased and bore along with it light clouds of sand; about 9.30 p.m. the storm commenced in all its fury. Vast bodies of sand were drifted violently along, the stars and moon were totally obscured, it became pitchy dark, and it was impossible to see the hand held close to the face. The wind blew furiously in gusts, and heaped the sand on the windward side of obstacles in its course. Lightning and thunder accompanied it and were succeeded by heavy rain. The storm lasted about an hour, when the dust gradually subsided; the sky again became clear, and the moon shone brightly,

[1] Noad's *Manual of Electricity*.

although the wind continued to blow hard for some time. The storm appeared to have entirely relieved the electrical condition of the atmosphere; a pleasant freshness followed, and the oppressive sensation before-mentioned was no longer experienced. This indeed is the general effect of such dust storms in Upper Scinde. The air is cooled, the atmosphere cleared, and the dusty condition of the atmosphere which usually precedes them for several days completely disappears.

These dust storms are probably analogous to the tornados of the Indian Seas; but I am not aware whether a circular current of the wind has been demonstrated. If so, they are nothing more than a dust column on a gigantic scale. They are frequently very much more severe than the one I have described, lasting for many hours and obscuring the sun at midday to such a degree that artificial light is necessary. If the unfortunate traveller is caught in one in the desert, he not unfrequently loses his life. They occur to some extent throughout Scinde; but it is in the centre of the desert tract that their full violence is chiefly felt.

Irrigation and cultivation would probably influence the climate of a district when thorough and continued, especially its electrical condition; but the good results are exceedingly tardy in operation, and the increase of cultivation on an extended scale is such a lengthened process that one can hardly hope for any great amelioration of the climate of Upper Scinde.

On the table land of Beloochistan dust storms are rarely experienced, and only in a mitigated form; but then the phenomena of electrical disturbance of the atmosphere are to be referred to the first two heads.

I can hardly close this meteorological sketch without mentioning the Simoon, that deadly wind which occasionally visits the deserts of Kutchee and Upper Scinde in common with similarly constituted tracts of country in the East.

Sudden, and singularly fatal in its effects, invisible, intangible and mysterious, it has ever been the dread of the desert traveller. So far as I am aware its nature is alike as unknown to the wild untutored inhabitants of the country of which it is a scourge, as to the European man of science. The presence of the simoom is made manifest by the sudden extinction of life, both animal and vegetable, over which its influence has extended.

Lieutenant Pastaus mentions it briefly in his report on Shikarpoor, submitted to Government in 1840, as occurring in the district of Kutchee. At the close of the hot weather in 1856 a party of five men were crossing the Put of Shikarpoor, being on their way from Kandahar to that city; the blast unfortunately crossed their path, killed three of them and disabled the remaining two.

In the year 1851, during one of the hot months, some officers of the Scinde Horse were sleeping on the top of General Jacob's house at Jacobabad. They were awakened by a sensation of suffocation, and an exceedingly hot oppressive feeling in the air, while at the same time a powerful smell of sulphur pervaded the atmosphere. On the following morning a number of trees in the garden were found to be withered in a remarkable manner. It

was as if a current of fire about 12 yds. in breadth had passed through the garden in a straight line, singeing and destroying every green thing in its course. Entering on one side and passing out on the other, its track was as defined as the course of a river.

The Moonshi of Major Henry Green, Honorary A.D.C. to the Governor and Political Agent at Khelat, is a native of Bogh in Kutchee, and gave the following description of the effects of one of these blasts, of which he was both an eye-witness and the sufferer. He was travelling in company with two other persons near Clulgherri, the site of a buried city in Kutchee about seven miles South-east of Bogh. They were all mounted; when about 2 a.m. the blast struck them. He was sensible of a scorching sensation in the air like the blast of an oven, but remembers nothing further, as all three were immediately struck to the earth. They were carried to Bhag, where every attention was afforded them, and after some days of sickness they recovered. He states that such phenomena are frequent in the desert; that the hot blast is usually preceded by a cold current of air; that it destroys every green thing in its course, and is most frequently fatal to human life. That the bodies of the dead quickly decompose, their flesh is withered, of which the firmness and consistency is destroyed, so that it falls or may be plucked off from the bones: and this not after decomposition has commenced, but immediately on death taking place. The treatment adopted by the natives is at once to wrap up the sufferer in a posteen or warm woollen clothes, and to administer a mixture of onions and pepper with the view of inducing perspiration; if this be established there is a hope of recovery.

The current passes "like a knife" through the air, leaving a well-defined narrow track. During the past hot season (1859) upwards of fifteen lives have been lost in the desert to the North-west of Jacobabad. Some of these may be attributed to sunstroke, but that the following is a well-marked case of the effects of the simoom admits of little doubt. Two syces and two camels were sent to Minoti, 20 miles to the North-west of Jacobabad, for grass. Not returning at the proper time it was feared that some accident had happened, and search was made. All four were found dead, the bodies lying together in one spot. Their deaths had been evidently instantaneous. Now had this been sunstroke both men might have been killed; but the sun, so far as I am aware, has never killed camels, and the fact of all four lying dead in one spot evidently points to something beyond the power of sunstroke.

From the above the following items of information respecting it may be gleaned:—

The simoom is sudden in its attack.

It is sometimes preceded by a current of cold air.

It occurs in the hot months, usually June and July.

It takes place by night as well as by day.

Its course is straight and defined.

Its passage leaves a narrow track.

It burns up or destroys the vitality of animals and vegetables.

It is attended by a well-marked sulphurous odour.

It is described as being like the blast of a furnace, and the current of air in which it passes is evidently greatly heated.

It is not accompanied by dust, or lightning and thunder.

If it be then neither a phase of sunstroke, lightning, malaria, or miasmata in a concentrated form, to what is it to be referred ?

I believe that it will be found to be a very concentrated form of ozone generated in the atmosphere by some intensely marked electrical condition; for it is well known that ozone is developed particularly in a highly electrical state of the atmosphere.

Ozone may be produced from dry oxygen by passing a succession of electrical sparks through it.

"Fremy passed the electric sparks on the outside of a tube which contained perfectly dry oxygen, and it was found to have acquired the properties of ozone. Ozone always exists in the air we breathe, but its quantity is subject to great and rapid variations. It is found that when electrical tension is high, the quantity of this principle is great; when the electrical tension is low, as in cholera years, the proportion of ozone is relatively low."

In fact, the researches of chemists have shown that ozone is set free in the atmosphere by electricity, that the quantity is subject to great and rapid variations, that it is constantly supplied by atmospheric electricity, and that unless again abstracted is liable to accumulate to a dangerous extent. It is again abstracted by oxidisable substances, organic matter, &c. If, therefore, a condition of climate and country be imagined where there is usually a vast amount of electricity and but a limited amount of organic life, the conditions would be favourable to the generation and accumulation of this gas. Now, these conditions of climate and country are to be found in the deserts of Kutchee, Arabia, Mesopotamia, and Nubia, where the simoom is prevalent.

Again, concentrated ozone resembles in its effects the simoom, "in that it is highly destructive to animal and vegetable life, and bleaches and destroys the texture and consistency of organic bodies; and is moreover attended by a peculiar and powerful sulphurous odour."

These considerations, added to the fact that the simoom is as likely to occur by night as by day, seem to indicate that its destructive effects are to be attributed, not to direct solar energy, but to the development of ozone in a highly concentrated condition.

I do not pretend to have solved this difficult question, but if I have been able to throw any light on the intricate problem, or even to direct the attention of others to the subject, I shall not have mooted it in vain.

DISCUSSION.

Dr. TRIPE said that some of the statements in the paper appeared to him to be in opposition to the present state of our knowledge on these subjects. Thus the author stated that the peculiar effects of the simoom were caused by ozone; that the blast had a very powerful effect on animal and vegetable life, destroying

almost everything. He (Dr. Tripe) did not believe that atmospheric ozone possessed the properties which Dr. Cook had ascribed to it, or that it could cause such disastrous effects as those described by the Moonshee. From observations he had made in London, it was evident that ozone was comparatively rarely found in the air of large cities, but outside of them, although Dr. Cook assumed that it existed at all times and in all places in the atmosphere. He could not agree to the statement that ozone has a sulphurous smell.

Dr. MARCET considered that Dr. Cook's description of dust storms and the electrical phenomena observed during their occurrence was very interesting. He (Dr. Marcet) had noticed, when on the Peak of Teneriffe, that the air was sometimes so dry that by rubbing a sheet with the hand it was possible to obtain streaks of electric light. It was well known that such displays could only occur when the air was very dry, and he had heard it stated, apparently on excellent authority, that at Ottawa, Canada, where the air was very dry in winter, the gas in a room had been lighted by rubbing the feet along the carpet and applying the finger to the burner. He thought the author's view of the simoom could not be sustained, as ozone was a most unstable substance, being quickly destroyed when in contact with even a trace of organic matter. The sulphurous smell which Dr. Cook said accompanied the dust storms, had been noticed during the presence of ozone in the atmosphere after a storm. It was a great pity no observations of air temperature were made in connection with the simoom, as they would prove very interesting. The sensations of travellers caught in this wind would also be instructive, as it was well known that ozone produced great irritation of the nose and throat. Ozone might be expected to bring on rapid decomposition of dead bodies, it being such a highly oxydising substance.

Mr. DONKIN said that although our knowledge of atmospheric ozone is rather indefinite, ozone has been proved by laboratory researches to be an allotropic form of oxygen, showing powerful chemical and physiological effects, such as strongly attacking the mucous membrane of the nose and destroying for a time the sense of smell. On a large scale, these destructive effects would no doubt be greatly intensified.

Captain TOYNBEE remarked that he had been disappointed in not learning something from the Paper or from the discussion, as to the cause of these gyratory dust storms. For instance, he would like to know whether extreme heat caused the dust storm, and the dust storms caused the remarkable electrical state of the atmosphere, or whether the electrical state of the atmosphere caused the dust storm?

Mr. SYMONS said that although he had never seen anything resembling the simoom, he remembered hearing of a curious case of a hot blast which occurred over a small district in this country some few years ago. A gentleman was walking down to his thermometer screen with the object of examining the thermometers, and had just reached the screen, when he saw the maximum thermometer rapidly go up several degrees, and at the same time he felt a severe pain at the back of his head. He immediately laid down under a tree, and after a little while, feeling better, he got up, and upon going to the thermometer screen again, noticed that close by there was a narrow path cut through the grass, plants, and trees, in which everything was killed. He (Mr. Symons) visited the place the following year, and then saw the effects of this hot blast. Respecting ozone, it was perhaps possible that the ozone of the meteorologist and that of the chemist were not the same. Dr. Tripe in his remarks had doubted the accuracy of the author's ideas respecting the cause of the simoom, but he had not advanced another theory in it place; besides which, it must be remembered that this Paper was written in 1859, and that considerable additions had been made to our scientific knowledge since that time.

Mr. ABERCROMBY said that the great prevalence of electricity during a dust storm might be due to the friction of the dust. He could corroborate Dr. Marcet's remarks respecting the lighting of gas in Canada by means of electricity generated by rubbing the feet along the carpet, as he had seen this done, and had also done it himself.

THE PRESIDENT (Mr. LAUGHTON) said that Dr. Cook was quite in agreement with numerous other travellers in attributing a certain poisonous nature to the simoom, apparently distinct from its heat and dryness. Whether this was due to

some extraordinary development of ozone, as Dr. Cook suggested, or to some other cause, the fact remained, that the air of the simoom was poisonous to men, to camels and to vegetation. He believed that the Mediterranean sirocco was so also, though not to the same extent: it withered green leaves and grapes; it appeared to be very dry, but it rusted iron-work; it turned meat putrid; paint put on whilst it was blowing would never set; and though not fatal to human life, it was deadly to human temper. It was certainly hot, but not by any means so hot as to account for the excessive discomfort which it produced. He hoped that Dr. Cook's Paper might turn inquiry on the very curious problem to which it called attention.

On Cirrus and Cirro-cumulus. By the Hon. F. A. Rollo Russell, M.A., F.M.S.

[Read April 18th, 1883.]

Next to frequent readings of the barometer, and a knowledge of the distribution of atmospheric pressure, observation of the character of clouds, especially of cirrus, is of the greatest use in attempting to forecast the weather. If, as I believe, certain kinds of upper cloud are almost invariably followed within a definite area by certain kinds of weather, every one who depends much on atmospheric conditions has in them an inexpensive index of much value as a guide to operations, whether by land or sea. Observation of cirrus can plainly be made use of in a telegraphic system of weather forecasts as easily as observation of the barometer, and the employment of a number of scattered cirrus observers largely increases the probability of this form of cloud being noted. If thoroughly-trained observers of clouds were employed to telegraph their observations from a few selected places in the British Isles, it is possible that the percentage of successful storm warnings would be higher than at present, and the greatest storms would be foretold almost with certainty many hours before their arrival.

Cirrus has been supposed generally to float at heights varying from 16,000 to 40,000 ft. and more, but according to Mr. Glaisher's balloon observations its height must often be much greater, probably over 15 miles. In structure it differs much from all other kinds of cloud. Its distinguishing characteristic in the commonest form is a fibrous or hair-like appearance, but even when not plainly formed in filaments there is seldom much difficulty in determining its nature. To define the generic differences by which it is recognised is not quite so easy, but the best mark of its nature is the apparent development by some determining force other than wind and the ordinary agglomerating tendency of condensed vapour in the forms which it assumes. The appearance of cirrus often strongly suggests its obedience to electrical influence in the determination of form, while moving as a whole with the prevailing upper current of wind. It is the only cloud which presents angular forms and parallel, or nearly parallel, threads or bundles of threads apparently kept apart from one another by repulsion. It is the only cloud which is not normally rounded in outline, and which is sometimes composed of striæ at right-angles or nearly at right-angles to each other.

It is the only cloud which sometimes appears to radiate from a point on or below the horizon, thus showing that the lines are parallel to each other, and their real length in their apparent direction.

The following are the most remarkable classes of cirrus visible in England, with the weather they signify, or at least precede, according to my observations during the last eighteen years, chiefly in the neighbourhood of London and in the South of England. It will be understood that the names given are merely suggested for temporary convenience of description.[1]

1. *Mares' tails* or bundles of drawn-out filaments, either straight, curved or here and there twisted or bent, either horizontally, or sometimes upwards or downwards. These clouds move either longitudinally, in a direction of their length, or, less commonly, transversely; may be either sparse or numerous, and are frequently seen in fine summer weather in a sky otherwise clear or in the presence of more or less cumulus or light low clouds. They also appear frequently in showery or doubtful weather, both in summer and winter. If the lines be long and straight, of simple shapes, not sharply defined, but as it were melting into the blue sky, or if the tails are turned downwards or the cirrus descends and turns into the strise of transverse cirrus or into cirro-cumulus, especially in the early part of the day, fine weather generally follows. A slow movement from a Northerly direction is especially favourable. Quiet-looking cirrus in long lines, of uniform texture, and with soft outlines, whether moving slowly or moderately fast, or apparently stationary, may be taken as a good sign. Sharp wisps and twists and fragments ramifying in many directions are of little consequence unless very similar to each other, but do not often appear in the most settled weather. If the tails or offshoots look much blown about, strong winds frequently, but not always, have preceded or will follow them; but when the branches are short, and lie in a great variety of directions, fine weather with a change of wind generally succeeds. Cirrus, at two very different elevations, occurs in showery weather or rain-storms, and the lower bed is then commonly of a flaky form and moves transversely to its length. The dissipation of cirrus at sunset must not be taken as a good sign. Cirrus moving fast and associated with a bank of cloud commonly signifies the approach of rain, but in summer it often happens that a large show of slow-moving cirrus ends in a cloudiness of short duration, without rain. In winter, ordinary mare's-tail cirrus is always worth observing by those who depend much on the weather, and its changes and direction of movement should be noted. With practice the direction and rate of movement can be roughly observed on land almost at a glance. Parallel and similar long streamers growing outwards from a straight spine, separated from each other by blue sky, and moving transversely, signify the approach of a storm, and as they present peculiar features, will be classed separately. To sum up, it may be stated that mare's-tail cirrus, when thin, somewhat indefinite, soft and long, and lying with the

[1] I regret that within the limits of this Paper I am unable to give a full description of cirrus observed before certain storms and on other occasions.

main lines in one direction, or else, if confused and detached, presenting a great variety of short feathery offshoots in different directions and moving slowly, is favourable; but when hard, dense, with a repetition of certain forms, and moving fast, more or less unfavourable. Examples of mare's-tail cirrus occurred on May 28th, 1863; July 1st, 1863; April 20th and 21st, 1864; August 26th, 1866; October 14th, 1866; January 31st, 1868; March 5th, 1868; and December 2nd, 1881, followed by very different sorts of weather.

2. *Tranverse, cross, or reticulated cirrus.* This form of cirrus frequently appears in conjunction with the last-described variety, and in moderate quantity signifies similar conditions of atmosphere and weather. It often consists of a small bundle or extensive web of lines or striæ of cloud, whose direction makes a large angle, often about 90°, to the cirrus filaments beneath which it floats, so that the crossed lines of the upper and lower cirrus present the appearance of a fine network. Sometimes, however, and perhaps most commonly, the upper cirrus is of an apparently more continuous texture than the lower, and through the web-like structure of the cross cirrus looks much denser and whiter. The ends of the cross cirrus generally stretch beyond the side-borders of the upper cirrus. Cross cirrus is sometimes developed with great rapidity, and almost always, I think, in connection with lines of mare's-tail or wisp cirrus. It is not apparently capable of a prolonged separate existence, at least in the filiform state. As a denser but rather evanescent cloud it may, perhaps, be seen alone. Often it seems to be formed by the descent of the higher cirrus, which turns into this variety, and then sometimes breaks into cirro-cumulus or cirro-stratus. Cross cirrus appears on a large scale in the presence of curdled cirrus, which will be described later, and stretches in thin threads across the lines of an approaching cirrus bank. If the sun shines on the bank about sunset, the great difference in the height of the upper and lower cirrus then becomes evident. Sometimes it happens that cross cirrus is at the higher altitude, and mare's-tail floating below it, as on the evening of April 5th, 1883. Cross cirrus is followed by all kinds of weather. When in great abundance it commonly precedes rain after a short interval.

3. *Auroral cirrus.* This form in its perfection is so rare that I do not remember having seen it more than a very few times. It consists of white misty rays or streamers shooting in straight lines apparently from a point near or beyond the horizon, and diverging from that point. It is thin and delicate as long as the ray-like form is fully preserved. The best example I have seen occurred on the 30th of December, 1881, from 7h. 5m. to 7h. 30m. p.m. It consisted of white radiant streamers from a point South-south-west, the direction also from which the cirrus was moving. The lines were straight and well marked, illuminated by the moon, and had much the effect of aurora borealis. On passing overhead they were seen to consist of thin cirrus, then just about turning to cirro-cumulus, composed of detached irregular fleeces. The cirro-cumulus soon predominated, and the peculiarity of the phenomenon ceased. When the cirrus had first passed over towards

the North-east, before the transmutation to cirro-cumulus was completed, transverse waves of nebulous light, greatly resembling transverse waves in a display of aurora borealis which I once saw, but not undulating, were more conspicuous than the radiant lines. At 10 p.m. the sky had become cloudy. Fair, quiet weather followed, with an East wind. So far as I have observed, this cirrus, which I believe is nicknamed "Noah's ark," is one of the most trustworthy indications of fine weather, unless of a gross or complicated character.

4. *Filmy cirrus.* This seems to be the thinnest and most transparent variety of cirrus or upper cloud. It has no definite outline, but spreads like a thin, hazy, uniform film over a portion of the sky, the blue colour of which is generally seen through it. The stars appear only slightly veiled by a thin mist. It never palpably grows into any other cirrus or cloud of importance. It is seen chiefly in showery, but also sometimes in fine, weather. It often follows showers, and may be observed in the bright intervals. It is remarkable as the only cloud of so delicate a nature from which any precipitation takes place. Sharp, though commonly short, showers of rain and snow come from it, and sometimes seem to fall from a perfectly clear sky. In this case the proximity of two different layers of cloud seems unnecessary for the production of rain.

5. *Sheet-cirrus, or pallio-cirrus.* This is a very important class of cirrus, and plays a large part in the vicissitudes of English weather. It commonly appears first either as a gradually increasing murkiness without any clearly-marked lines in its structure, until a tolerably uniform grey sheet covers the sky, or else it invades the sky from some quarter of the horizon, whence radiant streamers, lines, or tufts, of a white, grey, or dull appearance, stretch generally in a rather confused manner, the under surface of the sheet from which they seem to spring being not white, like all other kinds of cirrus, but light grey. This sheet then slowly overspreads the sky and obscures the sun. Whether the thicker part of the sheet be true cirrus or not it is difficult to say. One thing, however, seems pretty certain, that rain does not fall from the cloud as long as it remains purely cirrus, but only when it becomes associated with nimbus or shower cumulus. The agency of condensation may be supposed to be descending until the usual double layer and ordinary rain clouds of the lower levels produce precipitation. Sheet-cirrus occurs with Southerly and Westerly, but rarely with steady Northerly or North-easterly winds, unless a change to a Westerly or Southerly quarter is approaching. It may probably be a thickening from cirrus downwards until it merges into nimbus and rain commences. Whereas, when the sun or moon is covered by ordinary cumuli or other clouds or by fog, not thick enough totally to obscure it, the disc is fairly well defined, through a stratum of sheet-cirrus it appears with a halo, like the light of a moderator lamp through a ground-glass globe, a much greater scattering of light-waves taking place. Although the approach of such a bank of cirrus often indicates wind or rain, it is far from being always a bad sign, and the most careful observer can hardly predicate what will be the result. The

following points, however, may give some help towards forming a judgment. In fine summer weather, which has been dry and settled for some days at least, the formation of sheet-cirrus frequently occurs, especially in the afternoon, and the cloud passes off in the evening without rain or with only a few drops. The longer the dry weather has lasted, the less is rain likely to follow the cloudiness of cirrus. In general, a very slow movement and increase of sheet-cirrus is favourable, but there is always a considerable probability of rain, if dense, and the more the wind is inclined to back from a Northerly quarter with cirrus from South or West, the greater is the probability of rain. Local showers or thunderstorms frequently result. A large formation of murky white cirrus may merely indicate a backing of wind to an Easterly quarter. These cirrus banks should at all times draw the attention of the observer to the state of his barometer, and their direction and rate of movement should be noted. If associated with straight horizontal lines of high cloud, irregular in position, rain is less probable. In winter, a large increase of cirrus is of much more serious import. In unsettled weather sheet-cirrus precedes more wind or rain. Thus on the 17th of December, 1881, after a showery night with heavy squalls, the morning was fine from 8.30 a.m. till 0.30 p.m., when cirrus overspread the sky, and rain and strong winds followed during the afternoon. On the 19th of December, the weather having been fine since the 17th a bank of cirrus came up from West-north-west at 4 p.m. and a shower followed. The evening was windy, and a heavy gale occurred in the evening of the following day. A notable example of significant sheet-cirrus occurred on the 29th of April, 1882. On the 28th there was some rain in the morning, but the afternoon was fine, the evening cool and pleasant with soft round-edged cumulus clouds clearing off and yellow sunlight. There was a little cirrus. The night was fine and clear. Some days previously there had been thunderstorms in the Midlands, and at Richmond, Surrey, sharp hail-showers and sudden spurts of rain proceeded not from ominous-looking shower-clouds but from sheet-cirrus or else from ordinary nimbus. On the morning of the 28th small rain fell with some large drops intermixed. On the 29th of April at 8 a.m. the weather looked fine, but a bank of cirrus was approaching rapidly from South-west, and the pointers were just overhead. The bank grew rapidly in density, and became uncommonly uniform and dark grey. At about 11 a.m. it began to rain, the rain increased and became rather heavy and continuous with sudden variations in quantity. At 2 p.m. it was clearing, and the wind growing very strong from South-west. It blew hard all the afternoon, and the showers dissipated, the clouds coming fast from South-west. About 7 p.m. the gale was at its height and of great intensity. Soon after 8 p.m. it moderated. On the 17th of July, 1882, after about fifty hours of fine weather, the sky, which had been bright and clear till 8 p.m., quickly became covered with sheet-cirrus rapidly moving from South-west, and rain with a strong wind ensued from 5.30 to 7.15 p.m.

Sheet-cirrus does not often appear with other clouds except nimbus, scud, and a little cirro-cumulus or cumulus.

6. *Tufted, or shower cirrus.* This variety is a constant accompaniment of showers in showery weather, and borders the lower clouds with a crown of feathery tufts. It is distinguished, first, by its close companionship with cumulus, cumulo-stratus, and shower-nimbus; secondly, by the short offshoots or plumes inclining in many directions, somewhat resembling the tentacles of a sea-anemone, and by its apparently lower altitude than that of most forms of cirrus. If a shower be approaching from the West it may be seen shooting forth from the upper edge white feathery rays, often very irregular and crooked. When the shower has passed away to the East it may be seen again, edging the rear with similar ramifying shoots. It gives the impression of being an extension upwards of masses of cumulus, to an altitude where electrical influences determine a change of form. A good example occurred on the 9th of July, 1882.

7. *Fish-bone or vertebrate cirrus.* This, when fully developed, is easily distinguished. It consists of a stripe of cirrus of continuous or nearly continuous structure stretching across a great length of sky, fringed sometimes on both sides by detached crisp curls somewhat like wood shavings, giving the impression of being an intermediate form between cirrus and cirro-cumulus. The most distinctive features are the axial strip and the fringe, and small twisted appendages starting transversely from the axial line of the long cloud, as if repelled by it. Fish-bone cirrus moves fast, and in a direction either transverse to its length or longitudinally—generally the former. It may be followed either by an increase of cloudiness, probably cirro-stratus, or by clear bright weather. If moving transversely from a Southerly quarter, or if the outlines are hard, rounded, or strange, or if accompanied by small cirro-cumulus, there is more probability of bad weather than if moving in file from a point between West and North, but much depends on the general character of the clouds. It is seen both in summer and winter. Examples occurred on the 14th of December, 1881, and on the 3rd of August, 1882.

8. *Radial cirrus.* This is a species of which I have only once seen an example, and that was on the 18th of August, 1881, in Scotland. It consisted of a patch of cirrus nearly overhead, from which pointers proceeded like the rays of a star fish, apparently horizontally. These radial offshoots were white and distinct, like the body of the cirrus. Only one side of the patch of cloud was visible, the rest being hidden by cumulus, and the rays were of unequal length and not quite true to a centre. They were extended towards a high white stationary cloud resembling cumulus, which they seemed almost, but never quite, to touch. These clouds were all apparently motionless, and the phenomenon lasted many minutes in view. The weather was showery on the following day.

9. *Curdled cirrus.* This cloud is not an uncommon one, and often occupies a large part of the sky. It somewhat resembles a mass of skeins of worsted entangled together, or curdled milk, and presents a very confused appearance. It may consist of mare's tail above cross cirrus, much twisted and full of knots and lumps. It often indicates the approach of bad weather, but sometimes only a change of wind to an Easterly quarter, or distant rain

or electrical disturbance. If signifying a change of wind to the East, it is commonly of a misty and murky complexion. I find in my note-book the following epithets applied on different occasions to specimens of this kind of cirrus: woolly, fluffy, flocculent, murky, pocky, streaky, crossbarred, wavy, rounded, curly, chopped, puckered. The spotted and confused appearance of this variety clearly distinguishes it from other kinds of cirrus. It requires careful observation to discern in it the chief signs of stormy weather. It may be stated broadly that the more clearly marked, the more wavy, and in detached portions, with blue sky between, and the more rapidly moving, the worse will be the weather or the stronger the gales which follow. When the moon is seen through it, the sky is commonly said to look watery.

10. *Bar or ribbed cirrus.* This, although rather a rare form, is one of the most important for weather forecasts, and when observed, at least equal in value to the falling barometer as a danger signal. It consists of similar parallel or nearly parallel bars of dense cirrus separated by narrow intervals through which the sky is visible, and may partake of the character of mare's-tail cirrus or cirro-cumulus. Long parallel and similar streamers of cirrus stretching from a single spine, either straight or bent, and short thick cross ribs, connected by a long piece of cloud at one end or both ends, belong to the same atmospheric condition, and indicate the approach of much wind and rain. The rapid movement of a cloud, something between cirrus or cirro-cumulus, in distinct dense bars, in a direction at right angles to the length of the bars, is by itself a certain sign of a gale of wind. The better the definition of the bars and the smaller the intervals of sky between them, the severer in general will be the approaching storm. The cirrus or cirro-cumulus which assumes the condition of dense compact bands, instead of the irregular or fleecy form, should be particularly noted. Sometimes this form is so developed as to remind one of a gridiron. These bands move transversely. They generally precede the storm by from twelve to forty-eight hours. This is the species of cloud which, in conjunction with lower forms, is mainly concerned in the production of sudden showers of hail and rain.

11. There is a species of cirrus, which may from its appearance be named cumuloid or cumulo-cirrus if no better expression can be found, with large round bosses commonly seen against a blue sky. It moves generally rather fast in considerable masses; these may in some parts resemble mare's-tail or curdled cirrus. It often precedes heavy rains and wind. It appeared in the middle of the day on the 12th of November, 1882, sailing fast Eastwards, after a continuous stream of ill-defined bar cirrus, moving transversely, had been passing rapidly from the West since 1 p.m. on the 11th. Rain followed on the night of the 12th, and a gale from North-east succeeded on the 13th and 14th, and snow on the 15th. The same kind of cloud was seen in London on the morning of the 8th of the same month, when destructive thunder-storms visited the Midlands.

12. On Friday, the 17th of November, 1882, between 9 and 9.30 a.m., a display of cirrus or cirro-cumulus occurred of a kind which should perhaps be separately classed. It radiated in long lines of cirrus-like morsels from about

North-north-east, and was separated by regular spaces both transversely and longitudinally. It covered a large part of the sky and produced a magnificent effect, until covered by lower clouds.

The Meteorological Office at present issues daily charts and reports, forecasts of weather, and storm warnings, which, taken altogether, must save the country every year some hundreds of thousands of pounds' worth of property. A moderate extra expenditure on cirrus observations and night messages from the West coasts would be a useful addition to a service which is still far from complete. A great and terrible loss of life occurred on the East coast in the storm of the 14th of October, 1881, a storm which travelled with great rapidity, and broke upon the West coasts during the night. The barometer had sunk to a very low point on the Scotch coasts when the fishermen went out, but this warning seems to have been altogether neglected there. The cirrus observed on the 13th of October gave earlier intimation than the barometer of the coming storm. This is only a single instance of the great value of cirrus as a storm warning.

To sum up, it may be stated generally that cirrus of a long, straight, feathery kind, with soft edges and outlines, or with soft delicate colours at sunset and sunrise, is a sign of fine weather. Curly wisps and blown-back pieces are not a bad sign, but their exact appearance should be noted, as well as the rapidity of their movement, and the definiteness of their outlines. When the tails are turned downwards fair weather or slight showers often follow. Misty, confused, and curdled cirrus does not always foretell bad weather. The harder and more distinct the outline, and the more frequently particular forms are repeated, the worse the result. Long, hard, greasy-looking streaks, with rounded edges or knobs, whether crossed by fibres at right-angles or not, are a sign of storms; but the storm may pass at some distance from the point of observation. Cottony shreds, either by themselves or detached from a long streak, rounded and clear in outline, something between cirrus and cirro-cumulus, indicate dangerous disturbances. Regular wavy tufts, with or without cross-lines, are bad, especially if the tufts end not in fibres but in rounded knobs. Feathery cirrus, in thick patches at equal distances apart, is a sign of storm, or any appearance of definite waves of alternate sky and cloud. So is any regular repetition of the same form. Slightly undulating lines of cirrus occur in fine weather, but anything like a deeply-indented outline precedes heavy rain or wind. Cirrus simply twisted or in zigzag lines of a fibrous character often appears in fine weather, and if not hard or knotted or clearly marked off from a serene sky does not often precede any important change; but detached patches, like little masses of wool or knotted feathers, in a clear sky and of unusual figure, moving at more than the average rate, precede disturbances of great magnitude. Such was some of the cirrus observed on the 18th of October, 1881; the 23rd and 26th of November, 1881; and the 19th, 20th, and 21st of July, 1882. These were on each occasion followed by heavy gales, heavy rain, or thunderstorms in some part of the British Isles. On the 23rd of November the wave or mammillated form was remarkably distinct. Thin rays in straight lines are a good sign.

It may be of some interest to mention that the violent gale of the 23rd of August, 1882, one of the strongest known in summer in the Channel, was trebly indicated by cirrus as follows:—At 6 a.m. on the 22nd a small patch of disorganised cirrus passed rapidly overhead in a clear sky, transversely. At 8 a.m. very long and similar fibres stretched at right-angles from a long spine of cloud in the West and passed transversely overhead. This was a striking cloud, resembling a comb with extremely long thin teeth. One of these long teeth bent round near the end at right-angles to the greater part of the fibre. Some of the cirrus was sharply and similarly bent in every streamer, producing the appearance of a succession of crooked waves. At 11.45 a.m. a series of dense bars of ribbed cirrus appeared in several directions, and the sky became much clouded below this cirrus. The gale began the same night, reaching a maximum about 10 a.m. on the 23rd. The barometer had only fallen slightly at 1 p.m. on the 22nd.

On Cirro-cumulus. This cloud differs much in structure from cirrus and occupies a lower level. It is composed of rounded portions, often nearly circular, close together, with short spaces of sky between, or thinned at the edges and overlapping; but sometimes the cloud is continuous in streaks and sometimes appears continuous, especially if viewed laterally. It is next in height to cirrus. It may be divided into two classes—high cirro-cumulus and low cirro-cumulus. It often seems to be formed by the descent of cirrus. High cirro-cumulus is rather common in summer, and consists of a number of fleecy morsels near together, presenting a beautiful effect, especially if associated with fine examples of cirrus. If soft and delicate in outline, it may be followed by a continuance of fine weather; but if dense, abundant, and associated with cirrus, it signifies electrical disturbance and change of wind, often resulting in thunderstorms in some part of the country in summer, or in gales in winter. The former kind is frequently followed by some small change to wind or rain of short duration. High cirro-cumulus commonly appears a few hours or days before thunderstorms. It generally moves with the prevailing wind. It is much more common with Southerly than with Northerly winds. The harder and more definite in outline, the more unsettled the coming weather. In winter, clearly marked high cirro-cumulus is a sign of bad weather. If the cloud be continuous in long streaks, dense, and with rounded, knobby outlines, stormy weather follows generally within two or three days. Such streaks may have accompanying threads of cross cirrus above them, as on the morning of the 3rd of May, 1882. Sometimes high cirro-cumulus may be equally well termed low cirrus, and partakes to some degree of the cirrus character. This disorganised-looking cloud is often seen in stormy and unsettled weather, and moves rapidly.

Ordinary cirro-cumulus appears in fine weather in winter, and may be considered a good sign unless the edges be hard or oily. Its fleeces look larger than those of high cirro-cumulus partly owing to the smaller elevation, but also probably to a difference in size. Cirro-cumulus often shows itself prominently at sunset in fine weather with Northerly or Westerly winds, in

detached strips of elongated cloud continuous in the middle part and broken into fleeces along the edges. When cirro-cumulus is seen overhead, if the fleeces gently merge into each other, and the edges are soft and transparent, settled weather prevails, and if the middle part of the fleeces look shadowy, so much the better. When the sky is overcast with billows, with soft edges showing alternate light and shade, fair weather frequently, but not always, follows, and the co-existence of cumulus should be noted for the purpose of forecasting. There is a variety which may be called flaky cirro-cumulus, of which the edges are soft, and the substance often so thin that the sky may be seen through it. This cloud floats high, and its irregular flaky character is a very trustworthy indication of fine weather. It must not be confounded with a very similar flimsy cirro-cumulus which is seen in stormy weather and moves rapidly in patches or shreds, but it is common in fine frosty weather in winter, especially with Northerly and Easterly winds and in anticyclones and fog. Cirro-cumulus at a great height and in large masses moving slowly from North-east is a sign of the continuance of the wind in that quarter. On the 16th of August 1882 fine-weather cirro-cumulus appeared between 6 and 7.45 p.m. coming fast from North under cirrus, and only a few fleeces at 6.5 p.m., by the oily roundness of some small part of their outline, indicated rain or wind. Some rain accordingly fell at night, but a period of fine weather followed.

DISCUSSION.

The Rev. W. CLEMENT LEY, who was unable to be present, sent the following remarks on the paper:—"While welcoming every attempt to study and describe the structure of the modifications of higher clouds, he wished to point out what he considered the weak part of Mr. Russell's Paper, by no means as offering adverse criticisms, but rather as desiring to indicate the manner in which the author might most advantageously modify and develop his scheme of observation in the future. In the postscript of a note recently read before the Royal Society,[1] Prof. Tyndall said that from outsiders 'equipped with the necessary physical knowledge meteorologists may expect efficient aid towards introducing order and causality among their valuable observations.' He would not venture to insist on the use of this hint (which, by the way, did not contain for meteorologists compliment unalloyed), in reference to the numerous classes of those observations which had been amassed for many years, but he would apply it at once to the nascent branch of study which dealt with the structure of the clouds. Let this branch of study, at present one of the most obscure, but destined, as he believed, to become one of the most important, be henceforth attacked methodically, not from the point of view of the collector of observations, but from that of the student of physical causes. Mr. Russell associated certain forms of cirrus with local weather observed at the time of, or subsequently to, their occurrence, but he scarcely approached the most interesting and fascinating problems which are connected with the relations of the directions, velocities and positions of the bands of upper clouds to the distant cyclonic and anticyclonic circulations of the atmosphere. The real (as opposed to the apparent) posture of the upper cloud-bands was the first element which any one who wished to forecast weather should study: that one who had watched the cirri for eighteen years should omit in a Paper like this all the laws of weather relating to that element, was a proof that the author had never classified his observations with a view to ascertain the physical cause of the disposition of cloud-bands. It was in the power of any careful observer, and

[1] *Proceedings of the Royal Society*, Vol. XXXV p. 25.

therefore certainly of Mr. Russell, to work out useful results by a systematic study of the relations above mentioned, tracing the progress of depressions whose centres were many hundreds of miles distant. As a practical corollary, he would be enabled, by combining with this study an intimate knowledge of local characteristics of weather, to answer every day in the year without possibility of failure the question, "Is it needful to carry an umbrella?" and still more usefully to inform the farmer when it was and when it was not desirable to commence cutting or carrying his crops. But, above all, it would be possible for him to contribute valuable information towards the solution of those problems which were concerned with the movements of upper strata of that ocean of atmosphere in which we live, of the laws of which so little has until recently been ascertained. In Germany, Hann, Köppen, Möller, Linss, have attacked, mainly from the theoretical side, questions relating to the structure of various forms of clouds. England had a climate which, whatever might be said of it in other respects, was admirably suited for combining with investigations of that description a well-organised system of observation.

"He did not like to refer to results of his own, lest he should seem to be making an invidious comparison, but as the mention of particular results was more persuasive than any statement of principles, he would mention two forecasts, one of a general, and the other of a local character. On the 10th inst., at 4 p.m., he telegraphed from Leicestershire to the Meteorological Office as follows:—'Depression in extreme North, about to travel to coasts of Norway,' and the forecast proved correct. Now at the time of sending this message not the slightest symptoms of the existence of that depression could be found in the readings of any instruments in his possession, or in any phenomena whatever, excepting the motion relatively to the position of the bands of cirrus (or as he termed it *cirro-filum*) near the North-west horizon. Further, had he been in possession of the weather charts for the morning of the 10th, or as far as he knew of any then existing reports, he should not have been able to draw from them the inference which could at once be drawn from the observations of the upper clouds. On the morning of Whit Monday, 1881 (thinking that the information might be utilised by holiday-seekers in the Metropolis), he telegraphed from the Strand to the Meteorological Office, 'Thunderstorm ordered for London at 4 p.m.' But for the study of the changes in the disposition of the upper cloud-bands, it would have been utterly impossible for any one to conjecture the hour and position of the afternoon thunderstorm, the arrival of which was punctual.

"He might be allowed to add one piece of advice to those who were inclined to take up this subject. A classification of clouds, if framed on the lines of modification of physical structure, is naturally seriously complex. We must be on our guard against artificially making it more so. The effects of perspective are such that the same form of cirrus looks exceedingly different at different distances, different angles of sight, and different angles of reflected light. It would lead to endless confusion if these several appearances were classified as different types of cloud. The observer at least who was not prepared to enter upon a full investigation of the optical causes of those apparent differences which he had alluded to should carefully avoid any needless multiplication of subdivisions whether intended to be provisional or permanent. Mr. Russell's 'Auroral Cirrus' was a name for the bands of ice-cloud when these happened to extend on both sides of the observer's zenith, and when the observer looked lengthwise between and along them to the horizon, but it would be inapplicable to the same bands viewed laterally, as they might be by another observer twenty or thirty miles distant from the first.

"He would beg of Mr. Russell to reconsider his whole nomenclature. Nothing could be more unfortunate than the expression 'auroral cirrus,' not only for the reason already mentioned, but because it was sure to revive ideas of 'polarisation' and 'magnetisation' of the clouds, now happily almost exploded. Against the employment of such hybrid words as 'sheet-cirrus,' 'shower-cumulus,' &c. other objections might obviously be raised. 'Bar or ribbed cirrus,' consisting of 'long parallel and similar streamers stretching from a single spine, either straight or bent, and short, thick cross ribs, connected by a long piece of cloud at one end or both,' might surely be associated with the 'fish bone,' or 'vertebrated' cirrus. The weather watcher would run little risk by such a combination, since the form of cloud last mentioned was 'followed either by an increase of cloudiness, or by clear bright weather.'

"Under the head of "curdled cirrus" the author gave a string of twelve epithets, some of which did not seem mutually reconcileable. These certainly graphically represented the chaos of the old cloud world, the observers of which had for their motto the advice of Captain Cuttle, "When found, make a note of.'"

Mr. GASTER regretted that the author had paid so much attention to the mere appearance of the cirrus clouds, and so little to their movements. It must be evident to any one who read the Paper carefully that many of the author's different classes of cloud were, in reality, not at all different forms, but merely the same form viewed from different directions. This fact was fatal to the proposed arrangement; and in addition to this, there was evidence that some of the clouds referred to were certainly not clouds of the cirrus type at all. If the observer, instead of noting so carefully all the curves and bends in the cirrus lines, had recorded carefully their movements, and considered them in relation to the distribution of pressure prevalent at the time, he would have found them to be most invaluable aids to the forecast of weather. Mr. Gaster had frequently found them admirable guides as to coming weather long before the barometer gave any indication, but especially in cases where the barometric indications were not of a decided character; and Mr. Ley's forecasts, based mainly on them, were often most remarkable.

Capt. TOYNBEE remarked that the Paper subdivided the class of clouds generally known by the name of cirrus, and gave to each of the subdivisions a certain value as a weather prognostic. He thought that the observations by which certain weather was found to be connected with the existence of each kind of cirrus should be made known to and accepted as sufficiently proved by the scientific world, before that cloud should be allowed a separate name; for it must be remembered that each additional name increased the difficulties of observers, which were already very great. Still he would be one of the first to accept a new name when it was proved that the cloud to which it was given had decided value as a weather prognostic, not only in a given locality, but over the whole world. In explaining cloud observations to the captains and officers about to observe for the Meteorological Office his practice was to say:—All upper clouds which are not disposed in small lumps or ridges, and which are not spread uniformly over the sky, are named "cirrus." Those which are disposed in small lumps or ridges are named "cirro-cumulus." Those which are uniformly spread over the sky (like butter on bread) are named "cirro-stratus." He thought that these names, with the words "low" and "soft," at times when it was found that they appeared to be lower and softer than usual, together, of course, with the direction from which they were moving, and their apparent speed, were all that should be asked for from observers until there was good evidence that a certain type of cirrus was always accompanied by certain weather.[1]

Mr. CURTIS thought it most desirable to keep the nomenclature of clouds as simple as possible, and not to multiply subdivisions of primary types more than was absolutely necessary. He thought it doubtful if some of Mr. Russell's "classes" of cirrus were anything more than the same kind of cloud—probably due to precisely similar causes and atmospheric conditions—but viewed in different positions relative to the observer, and assuming very different forms in consequence. He found it a difficult matter at times to detect the motion of cirrus, especially when it was at a very great height, or when lower strata were moving rather quickly below it, and he thought a simple instrument, or plan, for use under such conditions very desirable. He believed that the height of cirrus clouds was very commonly under-estimated, and that it was generally very much more than 20,000 feet, and very rarely below that level.

Mr. ABERCROMBY considered Mr. Russell's Paper a very useful one. The author had endeavoured not to deal with the motion of clouds, but rather to classify them according to form, and on that account the Paper was valuable. He should much like to know to what form of cloud the name "Noah's Ark," alluded to by the author, was applied, as he had lately been making inquiries on

[1] After the meeting Capt. Toynbee sent in a note saying that a Lincolnshire farmer, who was a great observer of the weather, said to him, "When I see Noah's Ark with its windows open I expect fine weather, but when they are shut I expect rain." Unfortunately the cloud was not visible at the time, and the farmer was now dead. So far as Capt. Toynbee could understand his explanation, it was a long streak of cirrus of a peculiar shape. This somewhat accounted for the two characters given to "Noah's Ark."

the subject, but had as yet been unsuccessful. This form of cirrus was described as long converging stripes in Mr. Scott's book on *Elementary Meteorology*. It was generally believed that when the stripes extended from East to West, bad weather would follow, but when they extended from North to South fine weather might be expected. Auroral cirrus was, he believed, not a different form of cloud, but really converging cirrus of slight intensity. Cirrus was no doubt sometimes a useful prognostic in forecasting in conjunction with synoptic charts, and as showing a widespread belief in the value of prognostics, he mentioned a gentleman in Glasgow who endeavoured to organise a system of forecasting from prognostics only; but the scheme fell through, as it was found the expenses of telegraphing the observations would be too great. What was really wanted in weather forecasting was a prognostic which would foretell the intensity of an approaching cyclone.

Mr. WHIPPLE feared that it would be a difficult matter to classify clouds according to the names given in Mr. Russell's Paper, as cirrus clouds appeared to change their forms so quickly. He had observed a display of what was termed auroral cirrus on the 10th of April last; the cloud extended all across the sky, from the Northern to the Southern horizon, and lasted about an hour and a half. This display of cirrus was followed by fine weather. If, as had been said, the synoptic chart for a day could be seen in the heavens by a careful observer of clouds, certainly more attention should be directed to the subject, and he would suggest that photographic records of cloud formations and their distribution, for comparison with the Daily Weather Charts, would be a valuable contribution to the science.

Mr. STRACHAN remarked that a trial of prognostics founded on cirrus observations was now going on between Mr. Ley and the Meteorological Office. He also drew attention to Prof. Forbes's *Report on the Progress of Meteorology*, in which daily charts of cloud observations were advocated, and said that this was a matter which the Meteorological Office might very easily take up.

Mr. RUSSELL in reply said that he had intended to confine himself to a definition of the forms of cloud, and not to treat of their motion, to which he had paid less attention. Auroral cirrus, as far as he had observed it, was followed by fine weather. He did not imply by the term 'auroral' any connection with the aurora borealis. He might observe, however, that the great display of cirrus of another kind, seen in London between 9 and 9.50 a.m. on the 17th of November, 1882, coincided remarkably with the magnetic storm which began about 10 a.m. With regard to the storm of the 14th of October, 1881, the barometer in London, not the distribution of pressure on the 13th, was referred to.[1] Photographs of clouds would doubtless be valuable if they could be taken, but accurate drawings would be more practicable, and the daily cloud maps suggested would be of great use.

SOME NOTES ON WATERSPOUTS; THEIR OCCURRENCE AND FORMATION. By GEORGE ATTWOOD, F.G.S., Assoc. M.Inst.C.E., F.C.S., &c.

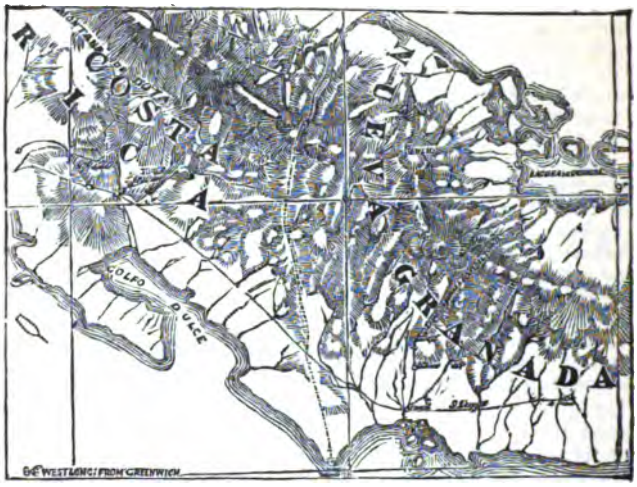
[Read April 18th, 1883.]

ON the 22nd of February, 1881, I was on board the Pacific Mail Steamship *Honduras*, bound for the City of Panama in the United States of Columbia (Fig. 1).

The ship was under steam, making about nine knots per hour, and the ocean calm, although a moderate head wind was blowing from the South-east. Numerous small dark clouds were observed drifting rapidly from the East, and evidently coming from the high peaks of the Costa Rica and New Grenada (or Columbian) mountains. The ship was about 15 miles from land, and in North lat. 8°·30′, and West long. 84°·06′ from Greenwich.

[1] The different appearance of cirrus at different distances did not seem to him an objection to noting the particular form, when ascertained.

FIG. 1.



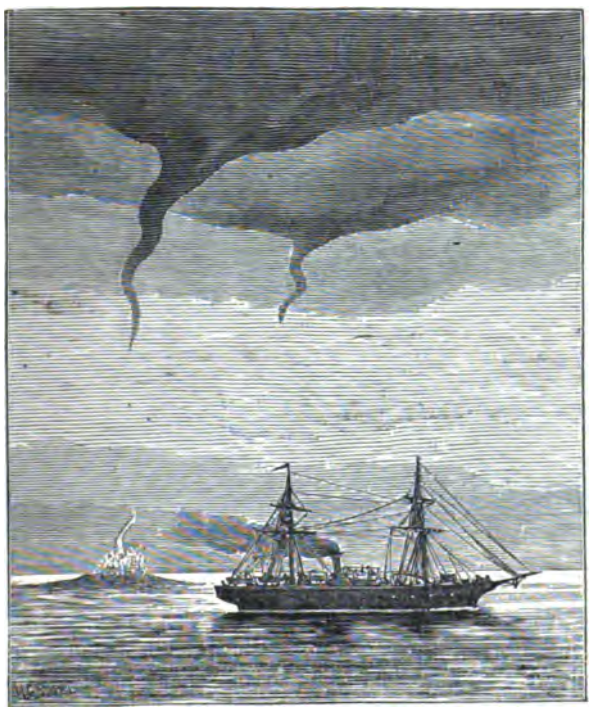
The barometer was about 30·20 ins., and the thermometer 83° Fahr. in the shade. At 6.30 a.m. I observed a waterspout about 800 yds. North-east from the ship. The diameter of the spout appeared to be about 8 to 12 ft. near the surface of the sea and then gradually to widen out until at a height of 1,200 to 1,800 ft., the dark cloud from which it originated, was reached (Fig. 2). The column of water was much influenced by the head wind.

FIG. 2.

Near the surface of the ocean the spout presented a peculiar appearance, and seemed to be formed of a fine, gossamer-like mist. Around the column, close to the ocean level, bubbles and spray were thrown up to a height of from 7 to 20 ft., and, from all I could observe, it might fairly be assumed that the column was delivering and not receiving water. The shape of the spout was that of an inverted, elongated cone, the centre of which was hollow, as the land and the mountains on the other side could be seen through the lower portions of the column. For a period of 20 minutes the spout continued perfect; when, suddenly, the connection with the ocean was broken, apparently by the wind, and without any of the water still in the spout falling into the sea after the severance. The gossamer appearance continued until the column was, little by little, absorbed by the heavy cloud from which it had emanated.

Before the disappearance of the first spout, a second one (Fig. 8) was formed from the same dense black cloud that produced the first.

Fig. 3.

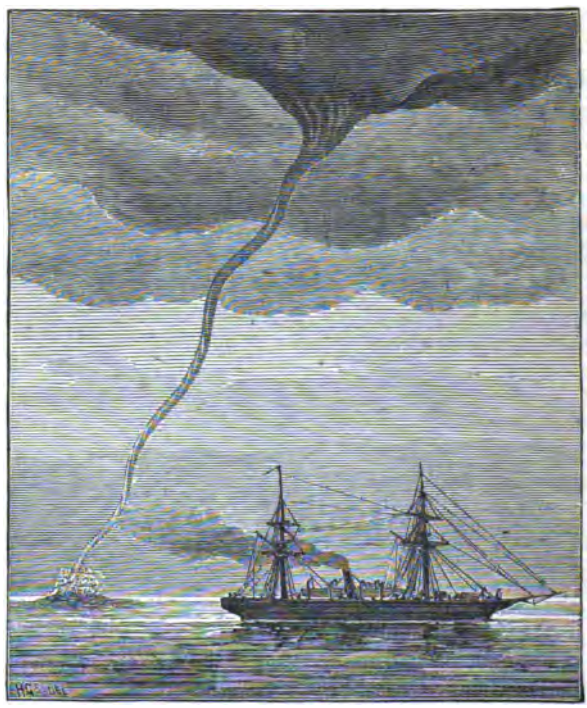


The wind meanwhile had slightly increased in strength, and the cloud had ascended to a much greater height. The column appeared to owe its origin to adjacent clouds that were drifting about coming in contact with the large black cloud. This caused an alteration in the shape of the part of the cloud that was heavily charged with water, although not separating

it from the main mass in its fall; and this assumed, with the aid of the wind, then blowing stiffly, the form of a circular column. This column did not appear to discharge any appreciable quantity of water into the ocean, although a connection was made with it; and no bubbles of water or spray were seen.

The height of the cloud was more than double what it had been at the first, and the spout presented a most beautiful appearance, resembling a long silvery tape composed of gossamer threads (Fig. 4).

FIG. 4.



The wind soon destroyed it in a similar manner to the first.

From the same cloud that had produced the two waterspouts already mentioned, a third, and the most interesting of all, was observed to issue.

The clouds were at the time being driven about in divers directions, at different altitudes, in three different strata, viz. :—

1st. The upper stratum, which was travelling at a great speed from the North in a Southerly direction.

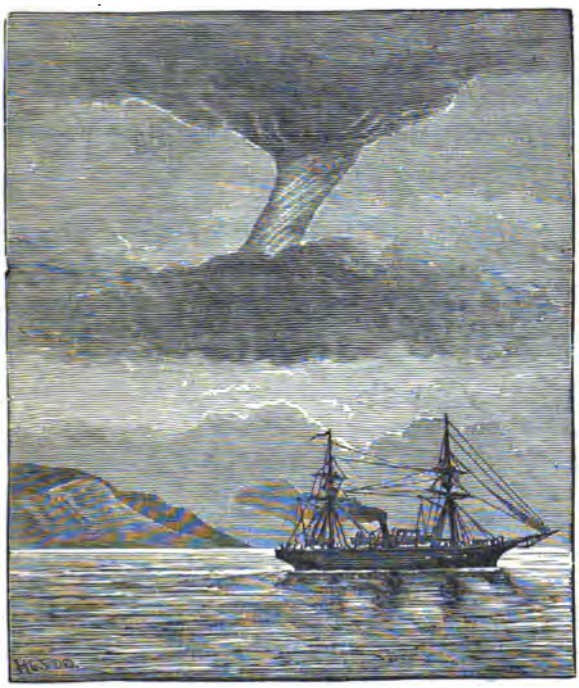
2nd. The middle stratum, consisting of a series of dense black clouds; some were small, but all of them were travelling from East to West, and they were apparently coming from the high mountain peaks of Costa Rica and New Grenada (the height of the above mountain ranges varies between

4,000 and 12,000 ft. above the ocean level); and the largest of these clouds produced the waterspouts so far noticed.

3rd. The lower stratum consisted of numerous small dark clouds near the surface of the ocean. These did not appear to be travelling in any particular direction, and they did not possess great density like those of the middle stratum.

The third waterspout started from a large cloud in the second or middle stratum, and instead of joining the ocean it attached itself to one of the clouds in the third or lower zone, which seemed to be drifting near and under it (Fig. 5).

Fig. 5.



The column exceeded by four times that of the first in its diameter, and it remained in view for fully twenty minutes, when it was lost to sight in mist, as if the clouds were amalgamated. In a short time, however, from the above clouds a small column was formed, but it failed to reach the sea or another cloud; and was soon taken back and absorbed by the dark cloud from whence it came.

Having described the waterspouts which I observed on the Pacific Ocean, I will give particulars of another spout which I observed on my return voyage to England on the Atlantic Ocean.

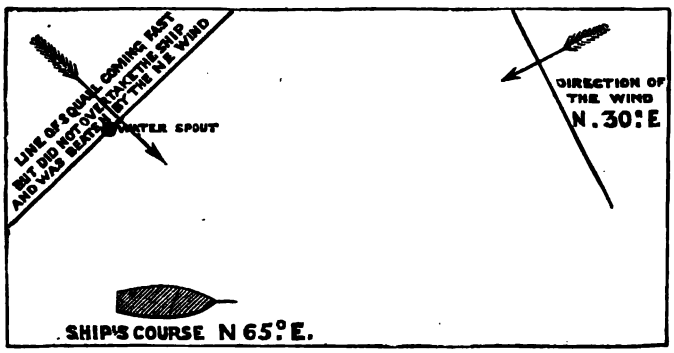
On the 20th of February, 1882, at 11.15 a.m., a heavy sea running, the

ship's course being N. 55° E. and in about North lat. 33° 12′, West long. 44° 50′, I saw from the quarter-deck of the Royal Mail Steamer *Don* a waterspout on the port (or North-west) side of the ship. The spout was distant from the ship about a mile, and was apparently 100 yds. in diameter at its base, which was on the surface of the ocean. It rose to a height of about 500 yds. Above it was a heavy dark black cloud, which seemed to be fully ten times as high as the top of the waterspout, but with which it was never connected.

The wind was blowing hard from about N. 30° E., and dense clouds were advancing from the same direction. Heavy squalls coming from the West and North-west had occurred all the morning after sunrise, but none of them had overtaken the ship, which was making about 12½ knots per hour.

The waterspout appeared to be formed on the surface of the ocean, on the edge of a long line of a white squall, which, coming into contact with the North-east wind then blowing, was driven back, and prevented overtaking the vessel, and at the same time gave the heavy waves, spray, mist and water cloud a violent rotatory motion which formed a hollow cone of water (Fig. 6).

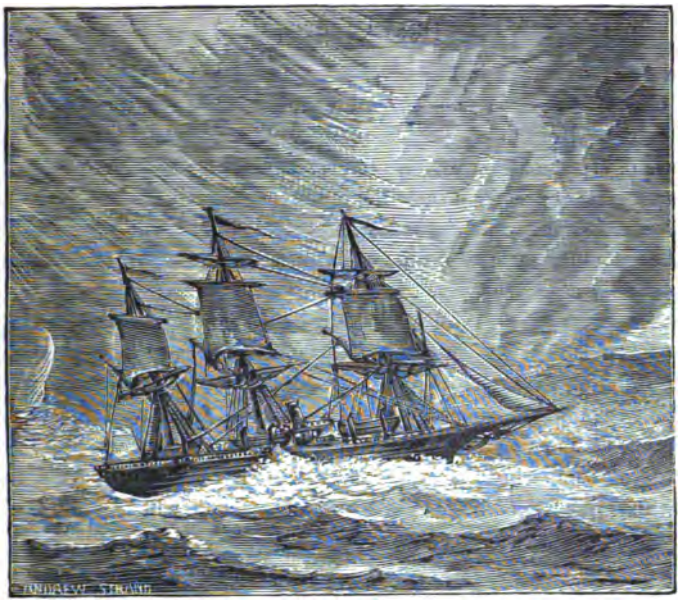
Fig. 6.



The waterspout continued for about ten minutes, and then slowly retired to the ocean, whence it originally came. Another cloud, for more than half an hour, attempted to form a spout, but it eventually disappeared in spray (Fig. 7).

In conclusion I may add that the waterspouts observed on the Pacific were not dangerous to shipping, with the exception of very small craft or open boats. The volume of water contained in them did not appear large, and the cones were hollow, having in places only a film of water. It would appear that they were caused by a cloud heavily charged with cooled moisture, drifting from the high mountains to the East, coming into contact with air currents and clouds travelling in a different direction, and of a warmer temperature; by which contact the cloud heavily charged with moisture was given a rotatory motion causing it to discharge part of its moisture, and make it assume a cylindrical figure and fall down by its own gravity.

FIG. 7.



The waterspout on the Atlantic was evidently caused by the contact of the cold heavy North-east wind with the warmer wind and rain squall which was coming up from the North-west and West, and I do not consider that it would be dangerous to shipping; as a sailing ship could avoid it, on account of the wind blowing; and even if it should come into contact with it, the volume of water appeared to be too small to do serious damage.

Captain Woolward, of the Royal Mail Steam Ship Company, in whose service he has been for upwards of 40 years, has had opportunities of observing numerous waterspouts, and he informed me that he should not be afraid to run his steamer against any waterspout that he had ever seen.

DISCUSSION.

Captain TOYNBEE thought that the author of the paper did not realise the fact that probably there was a violent whirl of air in connection with a waterspout; so that it was not falling water, but a violent though very limited tornado which might be experienced. Such tornadoes, only a few yards wide, had passed through a wood and cleared a path amongst the trees. The very disturbed state of the water under a waterspout was probably due to such a whirl of air, and he thought that Captain Woolward, who had been passing near them for 40 years, had shown his wisdom by never steaming into one.

Records of Bright Sunshine. By W. W. Rundell, F.M.S.

[Read April 18th, 1883.]

It has been said that in the two Westernmost counties of England there is more blue sky than in the Eastern counties, although the former are undoubtedly subject to a greater rainfall. An inspection during the early summer of 1881 of the weekly returns of bright sunshine issued from the Meteorological Office frequently reminded me of this statement. Falmouth and Pembroke generally showed the greatest number of hours of sunshine, and the inference seemed to follow that where there was most sunshine there was probably most blue sky.

Continuing my inspection of the *Weekly Weather Report* I was struck by the remarkable decrease in the amount of bright sunshine in many districts during the 8 or 10 weeks following the summer solstice as compared with the 8 or 10 weeks which preceded it. A similar decrease will also be observed during the summer of 1882. A still greater proportionate decrease will be observed on comparing the returns for the fourth quarter of 1882 with those for the first quarter of either 1881 or 1882. This will be seen by the summation of the weekly returns exhibited in Table I.

TABLE I.

Bright Sunshine in the United Kingdom in the Years 1881 and 1882.

Districts.	1	2	3	4	5	6	7	8	9	10
	hrs.	hrs.	hrs.	hrs.	hrs.	hrs.	hrs.	hrs.	hrs.	hrs.
First 13 Weeks, 1881	271	216	268	257	245	236	246	324	257	307
First 13 Weeks, 1882	294	230	243	210	239	164	159	245	227	235
Totals	565	446	511	467	484	400	405	569	484	542
Means	283	223	256	234	242	200	203	285	242	271
Second 13 Weeks, 1881	559	549	637	550	566	585	584	649	515	554
Second 13 Weeks, 1882	566	580	606	561	574	606	586	644	593	632
Totals	1125	1129	1243	1111	1140	1191	1170	1293	1108	1186
Means	563	565	622	556	570	596	585	647	554	593
Third 13 Weeks, 1881	409	458	559	531	605	455	474	678	461	502
Third 13 Weeks, 1882	474	481	519	441	493	463	425	528	372	446
Totals	883	939	1078	972	1098	918	899	1206	833	948
Means	442	470	539	486	549	459	450	603	417	474
Fourth 13 Weeks, 1881	229	265	303	315	303	238	251	379	309	324
Fourth 13 Weeks, 1882	147	139	173	156	188	131	129	186	174	211
Totals	376	404	476	471	491	369	380	565	483	535
Means	188	202	238	236	246	185	190	283	242	268
Means 26 Weeks, Summer	1005	1035	1161	1042	1119	1055	1035	1250	971	1067
Means 26 Weeks, Winter	471	425	494	470	488	385	393	568	484	539
Means for a Year	1476	1460	1655	1512	1607	1440	1428	1818	1455	1606

By grouping the quarterly means for the two years into winter and summer months, and projecting upon a map of the United Kingdom lines of equal numbers of hours of bright sunshine, Figs. 1 and 2, in the same way that lines of equal pressure are constructed from barometrical observations, some

TABLE II.

BRIGHT SUNSHINE AT TWENTY-SEVEN STATIONS IN THE UNITED KINGDOM DURING 1882.

Station.	1st 13 Weeks.	2nd 13 Weeks.	3rd 13 Weeks.	4th 13 Weeks.	26 Winter Weeks.	26 Summer Weeks.	Year.
	Hours.	Hours.	Hours.	Hours.	Hours.	Hours.	Hours.
Aberdeen	294	566	474	147	441	1040	1481
Durham	248	551	481	144	392	1032	1424
York	199	598	477	127	326	1075	1401
Hillington	184	587	518	118	302	1105	1407
Geldeston	279	656	574	216	495	1230	1725
Cambridge	249	595	498	192	441	1093	1534
Leicester	166	529	437	142	308	966	1274
Churchstoke ..	226	549	460	133	359	1009	1368
Cirencester	215	576	449	171	386	1025	1411
Oxford	209	579	473	171	380	1052	1432
London	178	512	403	130	308	915	1223
Marlborough....	259	572	503	179	438	1075	1513
Southampton ..	276	634	572	204	480	1206	1686
Glasgow.....	137	491	374	66	203	865	1068
Silloth	182	640	490	141	323	1130	1453
Douglas	184	696	523	182	366	1219	1585
Stonyhurst	146	568	412	125	271	980	1251
Llandudno	172	589	365	129	301	954	1255
Pembroke	206	701	527	195	401	1228	1629
Cullompton	242	545	507	162	404	1052	1456
Falmouth	275	671	557	209	484	1228	1712
Plymouth	252	627	514	158	410	1141	1551
Markree Castle..	231	572	364	192	423	936	1359
Armagh	217	618	374	193	410	992	1402
Dublin	258	634	444	187	445	1078	1523
Parsonstown ..	235	617	433	193	428	1050	1478
Valencia	221	644	464	249	470	1108	1578

new features in the distribution of bright sunshine become evident; and it will be seen that the blue skies of the South-western counties may be due quite as much to their proximity to the sea as to their more Southern position.

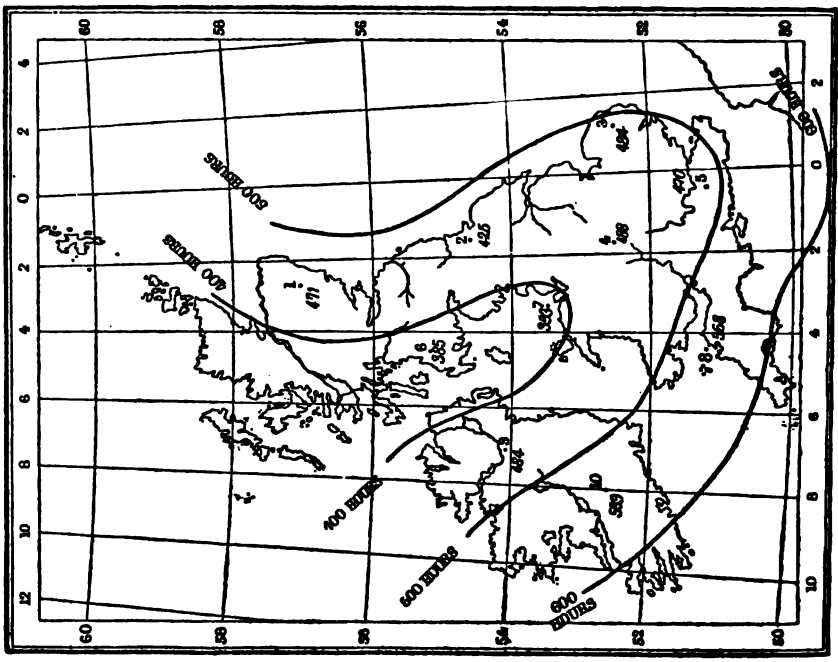
Speaking broadly, in all parts of the United Kingdom there is more bright sunshine upon the coast than there is inland. I am not aware that this has been noticed hitherto. This feature becomes more evident when, instead of taking the means of the 10 districts of the Meteorological Office, as in Figs. 1 and 2, similar maps are constructed from the returns of the separate stations.

This has been done in constructing Figs. 3 and 4 from Table II., which table sums the sunshine returns for 1882 into quarterly periods. Some small interpolations have been made in the records for a few stations for which returns had not been published for the full 52 weeks of 1882.

The diagrams for winter and summer both show the effect of proximity to the sea. That for the summer six months exhibits, I think, some rather unexpected features in the distribution of bright sunshine, especially the great amount of sunshine on the Eastern coast as compared with places on the Western coasts in the same latitude.

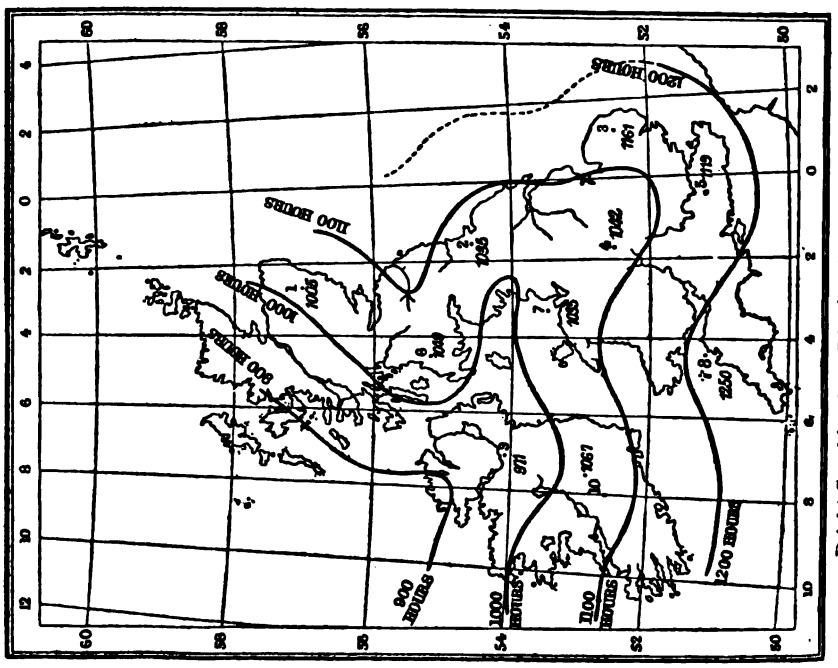
The East of Norfolk and Suffolk compare very favourably with the West

FIG. 1.



Bright Sunshine from District Means. Winter.

FIG. 2.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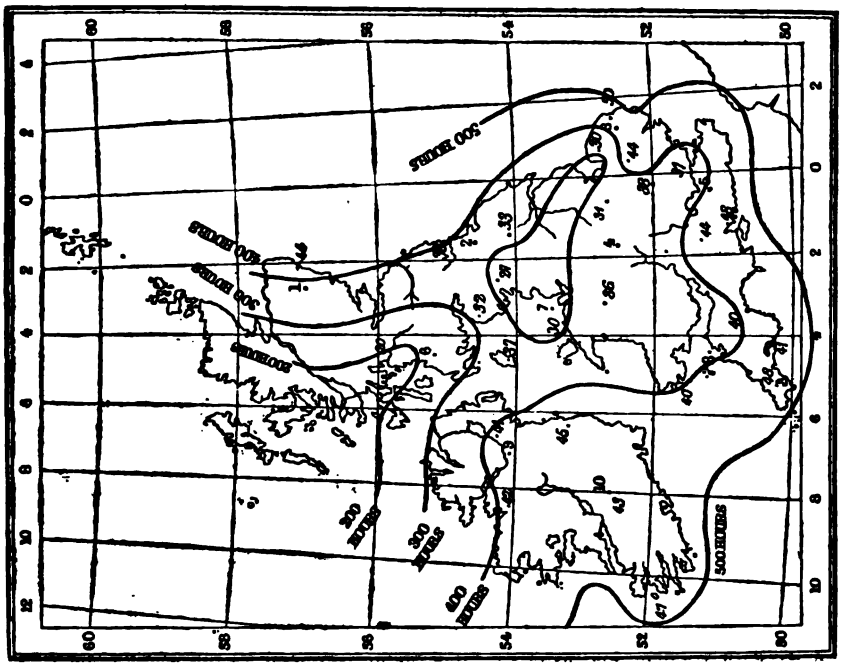


FIG. 3. Bright Sunshine, 1882. Winter.

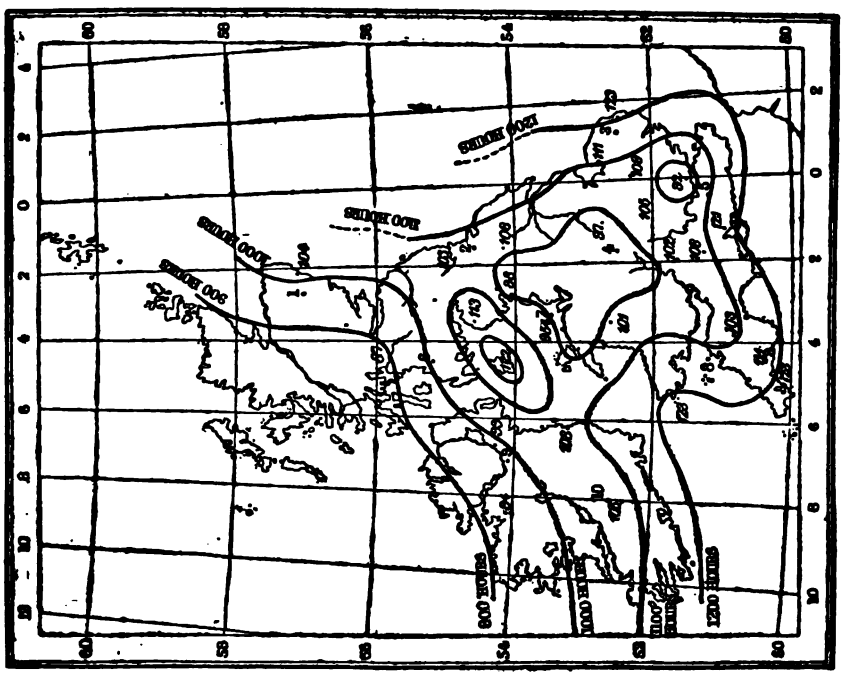


FIG. 4. Bright Sunshine, 1882. Summer.

of Pembroke and West of Cornwall. In fact Geldeston, on the borders of Norfolk and Suffolk, is conspicuous as having had the greatest number of hours of bright sunshine in 1882, both for the winter and summer six months. It must also be noted that the summer line of 1,200 hours of sunshine surrounds and isolates the Isle of Man in the same way that the line of 1,000 hours of sunshine isolates the London district.

The high position of the East coast as regards sunshine will no doubt be connected with the known small rainfall of the counties of Kent, Essex, Suffolk, and Norfolk.

The low position of Glasgow and also of London, as respects sunshine, is attributed to the prevalence in both places of smoke and dense fogs.

DISCUSSION.

Mr. SYMONS remarked that the Rev. F. W. Stow[1] had arrived at much the same conclusion as regards the part of the British Isles where the sun was most powerful; but that result was founded on observations of the black-bulb thermometer. He also drew attention to the difference between the amounts of sunshine recorded at Geldeston and Hillington, both of which were in Norfolk, and at no great distance apart.

Mr. GASTER mentioned that it would be unwise to accept, as final, results based on the records of the past three years, in which there had been practically no summer weather.

Mr. DYMOND believed that some of the differences in the amounts of sunshine recorded at places not very far apart were due to the way in which the burning of the card was measured by the observer. In particular, on cloudy days with frequent gleams of sunshine the measurement of the whole diameters of the spots produced would show an amount of sunshine greatly in excess of its real duration. On such days the sun would frequently in a few seconds burn a spot $\frac{1}{8}$ in. or more in diameter, the measurement of which would show ten or fifteen minutes of time. Care should be taken to measure only the movement of the centre of the spot.

Mr. LECKY remarked that he had tabulated the sunshine records taken at Aspley Guise, Bedfordshire, for the years 1881 and 1882, and from these it appeared that the spring of both years was very sunny, while the summer of 1882 was remarkable for its broken sunshine, being a bad ripening year for fruit.

Mr. CURTIS, referring to a remark by Mr. Dymond, said that the same method of tabulation was pursued both at Hillington and Geldeston, and therefore any comparative results would be unaffected by such an error in tabulation as he had mentioned.

Mr. WHIPPLE referred to, and gave extracts from, a short article by himself which appeared in the *Photographic Year Book* for 1883, on the subject of sunshine records. He also remarked that the local differences in the records of sunshine might be due, in some cases, to want of proper focussing of the sphere, as when the glass ball was out of focus the sun's image would cover a larger space of the card, and so cause more sunshine to be registered.

[1] *Quarterly Journal*, Vol. II. p. 205.

Note on Wind, Cloudiness, and Halos. By E. T. Dowson, F.M.S.

[Read April 18th, 1883.]

The wind and cloud results given in the following table and in the diagrams are derived from my observations at 9 a.m. and 9 p.m. at Geldeston, Norfolk, during three years (July 1879 to June 1882), and it has been suggested to me that they might be worth bringing before the Society.

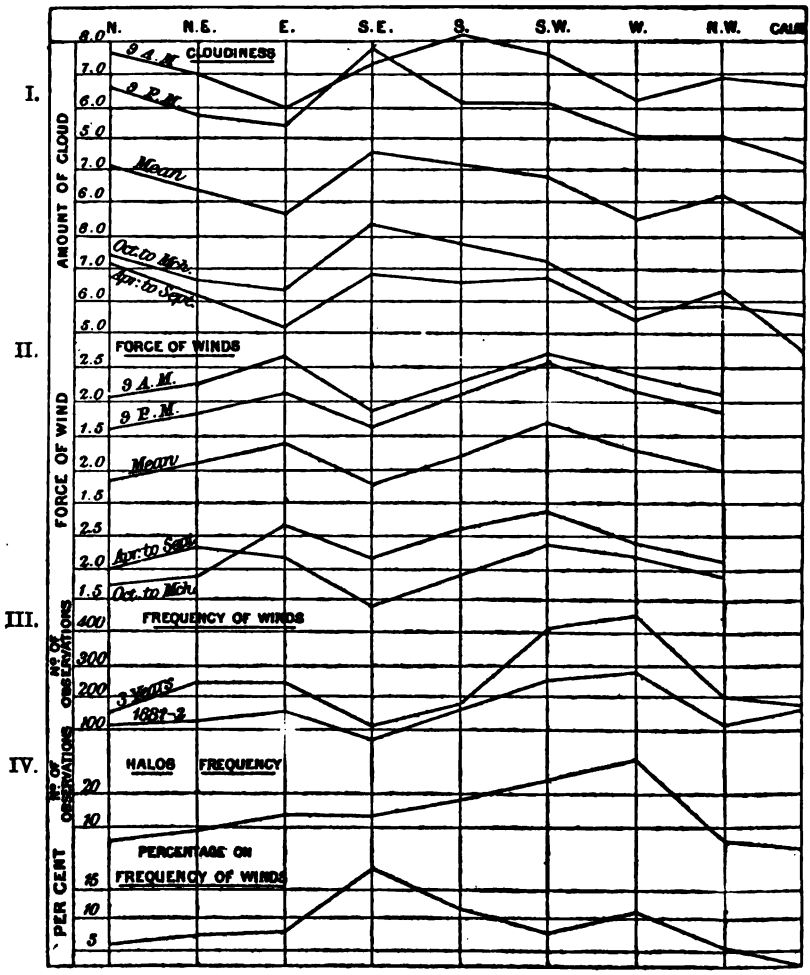
The amount of cloud was estimated on a scale 0 to 10, rejecting that portion of the sky from the horizon to half-way to the zenith. No anemometer was used, and the force is simply that of the Beaufort scale. The three years were all worked up together, and the totals divided by the number of observations to eight points, throwing the numbers due to the intermediate points alternately backwards and forwards. The position of the station is about 40 feet above the sea-level, and about half-way up the hill forming the North side of the valley of the river Waveney, which runs here through flat marshes ¾-mile wide, and but little above the level of the sea.

Diagram I. gives the amount of cloud with the different winds at 9 a.m. and 9 p.m., and also for the summer and winter half-years; and the curves show the decided excess of cloud at 9 a.m. over 9 p.m., except in the case of South-east winds; the maximum occurring with South winds at 9 a.m., and with South-east winds at 9 p.m.; the minimum of cloud with East winds at 9 a.m., and at 9 p.m. with Calms. Comparing the winter (October to March), and summer (April to September), half year, it will be observed that the former curve is traced above the latter except with North-west winds; the maximum amount of cloud is with South-east winds in winter, being 1·4 greater than with South-east in summer, in which the maximum is with North winds. The minima occur with Calms in both seasons. The mean curve shows that the maximum of cloud is visible with South-east winds and the minimum with Calms, the West and East points being about equal. It is interesting to note how the mean curve for South and South-west winds is influenced by the winter curve, whilst the Northerly (North-west to North-east) portions of the curve are more especially affected by the summer one.

Diagram II. represents the force of winds under divisions similar to those described above. The 9 a.m. curve always runs somewhat above the 9 p.m., and during the winter half-year the force considerably exceeds the summer record, except for North and North-east winds. The mean curve exhibits two maxima, that for East corresponds with one of the minima of cloud, and that for South-west indicates, though not exactly, a somewhat similar relation. The minimum force appears to be with South-east winds, and thus precisely accords with the position of maximum cloud.

Diagram III. is added to give the frequency of the winds, and more especially the number of observations on which the results are based.

Diagram IV. shows the curves with reference to the occurrence of solar and lunar halos with the various winds. The number of halos introduced is 125, the result of observations during 1881-2. It will be observed that



there is for West winds a marked correspondence with the wind frequency curve for 1881-2, showing that a larger number of halos is recorded with these winds on account of their prevalence. On the other hand, if we take the number of halos noted with each wind, and calculate the proportion to the frequency of each wind, we cannot fail to notice the decided preponderance of halos with South-east winds. So far as these results go, it appears that at Geldeston the South-east wind is the most cloud-bearing, the lightest in force, the least frequent (hence needing a much longer series than this note represents), and is accompanied by the largest number of halos in proportion to its frequency. I regret that I have not been able to work out results from similar observations made in various parts of the country. The figures from which the curves are derived are given in the following table:—

TABLE showing the Force and Frequency of Winds, and the Amount of Cloud and Number of Halos with each Wind at Geldeston, during 1879-82.

Force of Wind and Amount of Cloud.	N.		NE.		E.		SE.		S.		SW.		W.		NW.		Calm.	Mean Force of Wind.	Mean Amount of Cloud.
	Force.	Amount of Cloud.	Force.	Amount of Cloud.	Force.	Amount of Cloud.	Force.	Amount of Cloud.	Force.	Amount of Cloud.	Force.	Amount of Cloud.	Force.	Amount of Cloud.	Force.	Amount of Cloud.	Amount of Cloud.		
9 a.m.	2·1	7·6	2·3	7·1	2·7	6·1	1·9	7·5	2·3	8·1	2·7	7·6	2·4	6·2	2·1	6·9	6·7	2·2	7·1
9 p.m.	1·7	6·6	1·9	5·8	2·1	5·5	1·7	7·8	2·1	6·2	2·6	6·2	2·2	5·0	1·9	5·0	4·1	1·9	5·8
April to Sept.	2·0	7·1	2·3	6·1	2·2	5·3	1·4	6·9	1·9	6·7	2·4	6·8	2·2	5·5	1·9	6·4	4·4	2·0	6·1
Oct. to March	1·8	7·4	1·9	6·7	2·6	6·3	2·2	8·3	2·6	7·8	2·9	7·1	2·4	5·8	2·1	5·9	5·6	2·2	6·8
Mean	1·9	7·1	2·1	6·4	2·4	5·8	1·8	7·6	2·2	7·2	2·7	6·9	2·3	5·7	2·0	6·2	5·0	2·1	6·4

Frequency of Winds.	N.	NE.	E.	SE.	S.	SW.	W.	NW.	Calm.
9 a.m.	88	107	115	54	96	209	245	116	65
9 p.m.	80	136	133	52	88	196	203	84	122
Total	168	243	248	106	184	405	448	200	187
April to September	106	135	135	53	106	196	182	93	91
October to March	61	109	113	53	79	208	266	107	96
Halos and Wind, 1881-2.									
Frequency of Winds ..	110	116	164	73	162	258	288	110	176
Solar and Lunar Halos observed	7	9	13	13	18	24	31	6	4
Percentage on Frequency of Winds	6·4	7·9	7·9	17·8	11·1	9·3	10·8	5·5	2·3

PROCEEDINGS AT THE MEETINGS OF THE SOCIETY.

March 21st, 1883.

Ordinary Meeting.

John Knox Laughton, M.A., F.R.A.S., F.R.G.S., President, in the Chair.

Thomas Gustav Hawley, Park Hill, Kenilworth;
Sir C. William Siemens, D.C.L., LL.D., F.R.S., M.Inst.C.E., 12 Queen Anne's Gate, S.W.;
Cornelius Walford, F.I.A., F.S.S., Belsize Park Gardens, N.W.; and
Col. Henry Grant Young, Myrtle Villas, Malvern Wells;
were balloted for and duly elected Fellows of the Society.

Dr. Wladimir Köppen, Deutsche Seewarte, Hamburg, was balloted for and duly elected an Honorary Member of the Society.

The following Papers were read, viz.:—

"Note on a March to the Hills of Beloochistan in North West India in the Months of May to August 1859, with Remarks on the Simoom, and on Dust Storms." By Henry Cook, M.D., F.R.G.S., F.M.S. (p. 137.)

"OBSERVATIONS OF THE SOLAR HALO WITH PARHELIA SEEN AT THE RADCLIFFE OBSERVATORY, OXFORD, MARCH 16th, 1883." By W. H. ROBINSON. (See *Meteorological Record*, Vol. III. p. 7.)

After the reading of these Papers, the meeting was adjourned in order to allow the Fellows an opportunity of examining the following instruments which had been sent in for exhibition, viz. :—

FOURTH ANNUAL EXHIBITION OF INSTRUMENTS.

INSTRUMENTS USED BY DR. LIVINGSTONE AND OTHER EXPLORERS.

1. **Instruments used by Dr. Livingstone** during his last journey. Sextant by John Dalton, Hartlepool. Two Aneroid Barometers (Casella, 423 and 450). Prismatic Compass, by Cary.
Exhibited by THE ROYAL GEOGRAPHICAL SOCIETY.
2. **Two Aneroids used by Commander Cameron** during his journey across Africa. (Cary 236, and Casella 595.)
Exhibited by THE ROYAL GEOGRAPHICAL SOCIETY.
3. **Aneroid used by Lieut. Grandy, R.N.,** in the Congo Region (Cary 242). This instrument has continued in good order since it was supplied to Lieut. Grandy in 1872.
Exhibited by THE ROYAL GEOGRAPHICAL SOCIETY.
4. **Aneroid used by Mr. Keith Johnston, and afterwards by Mr. Joseph Thompson,** in their explorations in East Central Africa. (Cary 103) *Exhibited by* THE ROYAL GEOGRAPHICAL SOCIETY.

NOTE.—The above instruments, Nos. 1, 2, 3, and 4, have not been repaired, and are shown as returned to the Royal Geographical Society.

5. **Maximum and Minimum Thermometers used in Sir J. C. Ross's Antarctic Expedition 1839-43** (Adie, Liverpool 5.)
Exhibited by J. J. HICKS, F.M.S.
6. **Deep-Sea Thermometer, used in Sir J. C. Ross's Antarctic Expedition.** (Pastorelli 1). *Exhibited by* THE METEOROLOGICAL COUNCIL.
7. **Herschel's Actinometer, used in Sir J. C. Ross's Antarctic Expedition.** *Exhibited by* THE METEOROLOGICAL COUNCIL.
8. **Hydrometer, Gravimeter** (Newman 0·70), **used in Sir J. C. Ross's Antarctic Expedition.**
Exhibited by THE METEOROLOGICAL COUNCIL.
9. **Siphon Barometer,** by Newman, believed to have been **used by Sir E. Sabine in his Arctic Voyage,** 1827. It is a siphon of 0·25 in. diameter, mounted in a compact wooden case ; the scale is divided on brass, and it is provided with a slow motion screw for setting the vernier.
Exhibited by THE KEW COMMITTEE.
10. **Spirit Thermometer,** by Pastorelli, believed to have been **used in Sir R. Collinson's Arctic Expedition,** 1850-55, contrasting the maker's scale with the true scale at low temperatures. It has a box wood scale. A paper scale pasted over the wood differs from the original graduations by about 30° at —100°. On recent verification at Kew, the reading in freezing mercury, instead of being —37°·9, was found to be on the paper scale, —39°·5, and on the maker's scale —58°.
Exhibited by THE KEW COMMITTEE.
11. **Fortin Barometer** (Adie, 655), **used by Palliser in the British North American Boundary Expedition** in 1857, with tripod and case. This instrument has since been repaired and employed in comparisons of Standard Barometers at Kew, Greenwich, Oxford and elsewhere. It is an ordinary Fortin, with Adie's glass plunger cistern, tube 0·4 in. bore, graduated down to 12 ins. Its tripod consists of three brass rods screwed into a gimball frame which supports the barometer near its centre. *Exhibited by* THE KEW COMMITTEE.

12. **Hypsometrical Thermometer used by Sir Samuel Baker in Africa in 1862.** An ordinary Boiling Point Thermometer, 5½ ins. long graduated from 175° to 215°, divided to 0°·5, packed for carriage in a brass tube, lined with india rubber. *Exhibited by* THE KEW COMMITTEE.

13. **Siphon Barometer used by Capt. J. P. Basevi, R.E., in the high lands of Thibet,** 1873. It consists of a siphon tube tied to a paper-on-wood scale, divided by hand into tenths of inches, the whole being enclosed with cotton packing in a large split bamboo. The following label is pasted on the outside:—"This barometer, designed by Captain J. P. Basevi, R.E., was used by him in the high table lands of Thibet: it was afterwards returned to Dehra, and was used by Captain Heaviside at many places in India, at Aden and Egypt. Subsequently, when set up at Kew and compared, it was found to be free from error at a pressure of 30 ins. It may, therefore, I think, be deemed a good pattern for a travelling barometer. (Signed) W. J. HEAVISIDE, July 1874."
Exhibited by THE KEW COMMITTEE.

14. **Aneroids,** and other pocket apparatus, used for measuring heights, &c. in the Higher Alps, England and Wales.
Exhibited by J. S. DYASON, F.R.G.S., F.M.S.

TRAVELLERS' EQUIPMENTS.

15. **Instruments generally carried by Travellers** at the present time:—Two Standard Thermometers; Hypsometrical Apparatus, and two Boiling Point Thermometers (complete in leather case); One Set Maximum and Minimum Thermometers; Hygrometer; Aneroid Barometer (in leather case); Rain Gauge; George's Portable Mercurial Barometer, with tripod stand, &c., complete.
Exhibited by the ROYAL GEOGRAPHICAL SOCIETY.

16. **Porter's portable Travelling Case of Meteorological Instruments,** consisting of Hypsometrical Apparatus, Hygrometer, Maximum and Minimum Thermometers, Aneroid, and a combined Prismatic Compass and Clinometer. *Exhibited by* H. PORTER, F.M.S.

17. **Negretti and Zambra's Portable Set of Meteorological Instruments for the use of Travellers,** consisting of Maximum, Minimum, Dry and Wet bulb Thermometers, Aneroid, Improved Maximum Thermometer for hot springs, Solar and Terrestrial Radiation Thermometers, Hypsometrical Apparatus, Rain Gauge, and Clinometer. The whole arranged in a case 14 by 10¾ by 4½ ins.
Exhibited by Messrs. NEGRETTI & ZAMBRA.

HYPSOMETERS.

18. **Wollaston's original form of Hypsometrical Apparatus,** with two Boiling Point Thermometers (in leather case).
Exhibited by THE ROYAL GEOGRAPHICAL SOCIETY.

19. **Wollaston's improved Hypsometrical Apparatus,** with two Boiling Point Thermometers (in leather case).
Exhibited by THE ROYAL GEOGRAPHICAL SOCIETY.

20. **Hypsometrical Apparatus fitted to Bull's Eye Lantern.** Two forms of this instrument are shown, one with the place for the Thermometer at the side, the other on the top.
Exhibited by THE ROYAL GEOGRAPHICAL SOCIETY.

21. **Welsh's modification of Regnault's Boiling Point Apparatus,** designed for travellers' use, and exhibited at the Paris Exhibition of 1855. This is a double telescopic tube, Regnault's Hypsometric Apparatus, when closed, being 9 ins. in height, and when open 22 ins.; the diameter of boiler is 4 ins. The lamp, screened by wire gauze, is a Russian blast spirit lamp. *Exhibited by* THE KEW COMMITTEE.

22. **Casella's Small Hypsometer,** in pocket case for travellers.
Exhibited by L. CASELLA, F.M.S.

BAROMETERS.

23. **Mountain Barometer,** Fortin pattern, the case forming its tripod stand.
Exhibited by G. J. SYMONS, F.R.S.

24. **Mountain Barometer,** made by West, of Fleet Street, with leathern cistern, scale for capacity correction, divisions on strip of brass attached to wooden mounting, rackwork vernier reading to 0·001 in., attached thermometer arranged for removal so as to be also used to obtain air temperature.
Exhibited by G. J. SYMONS, F.R.S.

25. **Mountain Barometer,** made by Dollond, of St. Paul's Churchyard. Leathern bag and Reservoir siphon cistern with tap, making it resemble a Fortin, divisions, thermometer, &c.. as in No. 23, except that vernier slides, besides having rackwork fine adjustment.
Exhibited by G. J. SYMONS, F.R.S.

26. **Newman's improved portable Mercurial Barometer.**
Exhibited by THE ROYAL GEOGRAPHICAL SOCIETY.

27. **Portable Mercurial Barometer,** made by Troughton and Simms.
Exhibited by THE ROYAL GEOGRAPHICAL SOCIETY.

28. **Gay Lussac's Mountain Barometer.** *Exhibited by* L. CASELLA, F.M.S.

29. **Patent mercurial pocket Barometer,** invented by Telford McNeill, C.E. In this instrument the atmospheric pressure is determined by measuring the volume occupied by a definite quantity of air by means of compression. *Exhibited by* L. CASELLA, F.M.S.

30. **Portable Barometer,** graduated on the glass tube, with a sliding vernier, invented by Sir John Richardson, M.D., F.R.S., and used by him in his expeditions in North America.
Exhibited by THE METEOROLOGICAL COUNCIL.

31. **George's portable travelling mercurial Barometer,** with the spiral-cord for filling (See *Q. J.* Vol. II. p. 29). *Exhibited by* H. PORTER, F.M.S.

32. **Bogen's Patent Siphon Barometer, for Travellers.** This barometer possesses the following special features:—It is so constructed that it can easily be put together and taken to pieces again. The exhaustion is effected by a particular manipulation, termed by the inventor "pumping." (See *Q. J.* Vol. V. p. 137). The barometer is mounted on a peculiarly shaped stand, which has three adjusting screws, by means of which the verticality of the instrument can be ensured.
Exhibited by W. MARRIOTT, F.M.S.

33. **Two Aneroid Barometers** for travellers. *Exhibited by* L. CASELLA, F.M.S.

34. **Field's Engineering Aneroid Barometer,** with scale of altitudes, adjustable according to the temperature of the atmosphere. (See *Q. J.* Vol. II, p. 10). *Exhibited by* L. CASELLA, F.M.S.

THERMOMETERS.

35. **Set of Thermometers** in pocket case for Alpine travellers.
Exhibited by L. CASELLA, F.M.S.

36. **Set of Thermometers,** as expressly arranged for Livingstone's last African expedition. *Exhibited by* L. CASELLA, F.M.S.

37. **Portable Dry and Wet-Bulb Thermometers,** by Casella. Size, outside of case 9 × 2¼ × 1¼ ins. Weight 10½ oz.
Exhibited by THE HON. R. ABERCROMBY, F.M.S.

38. **Portable Maximum and Minimum Thermometers,** by Casella. Size, outside of case 10¼ × 2⅜ × 1 in. Weight 13¾ oz.
Exhibited by THE HON. R. ABERCROMBY, F.M.S.

39. **Four Low-range Thermometers,** Pastorelli, 19 and 23; Newman, 16; Casella, 1524. *Exhibited by* THE METEOROLOGICAL COUNCIL.

40. **Extra Sensitive Straight Bulb Mercurial Thermometer** for observations in Balloons. *Exhibited by* THE METEOROLOGICAL COUNCIL.

COMPASSES, &c.

41. **Chinese Pocket Compass.** *Exhibited by* G. M. WHIPPLE, B.Sc., F.M.S.

42. **Traveller's Pocket Compass and Sun-Dial.** Age unknown. Made by Krigner, of Warsaw. Only the four cardinal points are marked, and they have abbreviations of the Latin names, viz, SE (for *Septentrionalis*), ME (*Meridianus*), OR (*Orientalis*), and OC (*Occidentalis*). The gnomon of the dial is formed by a stout bristle, which throws its shadow on the inside of a silver circle; this is engraved to show every ¼ hour, from 3.30 a.m. to 8.30 p.m. The bristle is carried by this circle which has a very ingenious adjustment for latitude, rising and falling (by double cams) in accordance with an index, which can be turned to point on a small circle to any degree of latitude. There is also a small plumb-bob to level the instrument. The case is of copper, gilt and chased. On the bottom of it, and protected from wear by a raised rim, are engraved the latitudes of 43 places.
Exhibited by G. J. SYMONS, F.R.S.

43. **Patent 3-inch combined Altitude Instrument and Prismatic Compass,** with Azimuth glasses. The diameters of the Compass Dial and Altitude Circle are both 2⅜ ins., Prismatic Compass Dial being divided to half degrees and Altitude Circle in same manner, which circle has also a scale of rise and fall in inches per yard.
Exhibited by MESSRS. F. BARKER & SON.

44. **Patent 4-inch combined Altitude Instrument and Prismatic Compass,** same style as No. 43, but without Azimuth glasses.
Exhibited by MESSRS. F. BARKER & SON.

45. **Patent combined Altitude Instrument and Prismatic Compass,** hunter form. The diameter of the Compass Dial and Altitude Circle are both 1¾ inch, Prismatic Compass Dial being divided to degrees, and the Altitude Disc in same manner. The Circle has also a scale of rise and fall in inches per yard.
Exhibited by MESSRS. F. BARKER & SON.

46. **Pocket Hunter Prismatic Compass,** with Azimuth glasses. Although only 2 inches diameter, this instrument possesses all the advantages of a 3-inch Prismatic Compass, and can be used as an ordinary Compass without opening the cover, and as a Prismatic Compass by raising the cover, which carries a stout glass, on the inside of which is etched a line answering for the sight.
Exhibited by MESSRS. F. BARKER & SON.

47. **Bogen's Travellers' Artificial Horizon.** This is a contrivance for combining the mercury bottle with the trough in one casting, a mica disc being employed as a substitute for a glass roof. The bottom of the trough is provided with ridges to prevent oscillation of the mercury.
Exhibited by THE KEW COMMITTEE.

48. **Circular Artificial Horizon.** When not in use, the mercury can be shut off in the lower cistern. *Exhibited by* L. CASELLA, F.M.S.

49. **Casella-Galton Pocket Altazimuth.** A strong, handy, and very accurate instrument for obtaining Altitudes, Azimuths, Compass-bearings, clinometric degrees and levels; with staff.
Exhibited by L. CASELLA, F.M.S.

50. **Traveller's Transit Theodolite,** for Alpine and Military surveying, and occasional Astronomical Observations, described by Lieut. Col. Strange, F.R.S., in the *Report of the British Association* for 1869.
Exhibited by L. CASELLA, F.M.S.

51. **A portable Equal Altitude Instrument,** of unknown age. It has dark glasses for viewing the sun, a rough net-work of cross wires in the field of view, and extremely delicate adjustments for ensuring the perpendicularity of its axis; it is provided with a quadrant for indicating altitudes, but the divisions are very rude. The oak case in which it travels is evidently of great age. *Exhibited by* G. J. SYMONS, F.R.S.

MISCELLANEOUS.

52. **Small Rain Gauge** (Livingstone pattern), a portable form of instrument for Travellers. *Exhibited by* L. CASELLA, F.M.S.

53. **Sir W. Thomson's Portable Electrometer.** First model. This is the instrument used by Sir W. Thomson, F.R.S., with a burning match collector, and described in *Nichols's Encyclopædia* and in the *British Association Report* 1859, Sections, p. 27. *Exhibited by* THE KEW COMMITTEE.

54. **Sir W. Thomson's Portable Electrometer.** Improved Model. This instrument, described in the *British Association Report* for 1867, measures the Electrical potential of the Air by means of the degree of repulsion exerted against each other by two charged discs. The electricity is collected by a burning match.
Exhibited by THE KEW COMMITTEE.

55. **Sir Snow Harris's Anemometer** for elongating the indications given by the Lind's instrument. *Exhibited by* L. CASELLA, F.M.S.

56. **Portable Dip Circle.** This was formerly the property of Sir George Schuckburgh, F.R.S., it has a 3½ inch needle, and the divisions on silver are very fine, being each 15′ (about 135 divisions to an inch). It is believed to have been divided by Ramsden, but bears no name.
Exhibited by G. J. SYMONS, F.R.S.

57. **Goolden-Casella's Dip Circle.** *Exhibited by* L. CASELLA, F.M.S.

58. **Travelling Photographic Apparatus,** with Hare's Camera with Cadett's pneumatic shutter for rapid exposure. *Exhibited by* W. F. DONKIN.

59. **A mode of bracing a Drawing Board on to the top of a Tripod,** thereby forming a firm stand for a Camera Lucida, or for a Photographic Camera. There are six light steel ties and one strut, fitted with a right and left hand screw, which acts on all the ties simultaneously.
Exhibited by R. J. LECKY, F.M.S.

60. **Pressure boards and, apparatus** used in experiments on Distribution of Wind Pressure on Flat Surfaces perpendicularly exposed to the Wind.
Exhibited by R. H. CURTIS, F.M.S.

NEW INSTRUMENTS OR NOT EXHIBITED BEFORE.

61. **Aneroid Barograph,** by Richard frères, Paris. This instrument gives a continuous trace for 7 days. Size, outside case only 11 × 6 × 5½ ins. Weight 7 lbs. *Exhibited by* THE HON. R. ABERCROMBY, F.M.S.

62. **Cripps's Thermograph** for continuous registration of temperature.
Exhibited by L. CASELLA, F.M.S.

63. **Klinkerfues's patent Weather Indicator.**
Exhibited by Messrs. BIERNATZKI & Co.

64. **Klinkerfues's patent Universal Hygrometer,** for indicating simultaneously the percentage of atmospheric moisture and the dew-point.
Exhibited by Messrs. BIERNATZKI & Co.

65. **Klinkerfues's patent "Avertisseur,"** for predicting White Frost, Thunderstorm, Hail, and Wind. *Exhibited by* Messrs. BIERNATZKI & Co.

66. **Dines's Dew Point Hygrometer,** with latest improvements. This instrument can be used with water, but has been mainly designed for use with ether, which is stored up at the back part of the case. By inclining the instrument forward the front chamber is filled with the ether, and on opening the two small taps it is ready for use. After being used the taps are closed. *Exhibited by* G. DINES, F.M.S.

67. **Thirty-five Mercurial Thermometers with a constant zero,** which have been constructed in a special manner. To prove that the Thermometers were newly made, the pieces of enamel stems were sent to the Kew Observatory, and hall marked in March, 1881, previous to having their bulbs blown. They were then constructed into Thermometers, graduated, returned to the Observatory and tested throughout in June, 1881. Subsequently, they were placed under seal by the Superintendent, and remained so for over twelve months, and were again tested; the zero being practically constant. *Exhibited by* S. G. DENTON, F.M.S.

68. **Casella-Goolden doubly adjustable Electrical Six's Thermometer.** Suitable for Hospital Wards, Refrigerators, Heating Apparatus, &c., and can be used in connection with mechanical arrangements for the automatic regulation of temperature or ventilation.
Exhibited by L. CASELLA, F.M.S.

69. **Universal Sunshine Recorder and Sun Dial,** with Prof. Stokes's Zodiacal frame, and correctly divided cards, adjustable for all latitudes, with a sphere of pure optical glass. *Exhibited by* R. J. LECKY, F.M.S.

70. **Improved Transit Instrument,** with 13-inch telescope and 1½-inch aperture, with Tables for the same. This instrument has been designed for popular use, and for the special purpose of obtaining true time.
Exhibited by J. LATIMER CLARK, M.Inst.C.E., F.M.S.

71. **Dial for referring Clock-stars Right Ascension to mean time,** designed by G. M. Whipple, F.M.S. *Exhibited by the* KEW COMMITTEE.

DRAWINGS, MODELS, &C.

72. **Life size portrait of the late John Lee, L.L.D., F.R.S.,** one of the founders of the Meteorological Society, and President 1855-6.
Exhibited by R. INWARDS, F.M.S.

73. **Full size drawing of an Atmospheric Vapour Meter.**
Exhibited by G. DINES, F.M.S.

74. **Studies of typical Clouds in Monochrome,** made by Mr. Dyason in 1882. *Exhibited by* J. S. DYASON, F.R.G.S., F.M.S.

75. **A series of coloured sketches of Clouds** depicting various phases of the weather drawn in the North-west of London, by Mr. Dyason, during the years 1882-83.
Exhibited by J. S. DYASON, F.R.G.S., F.M.S.

76. **Copy of a year's Sunshine Records as obtained at Aspley Guise, Bedfordshire,** by Mr. E. E. Dymond, F.M.S.
Exhibited by R. J. LECKY, F.M.S.

77. **"The Shores of the Polar Sea,** by Dr. Moss."
Exhibited by J. K. LAUGHTON, PRES.M.S.

78. **Cartoon of a Vessel designed for automatically compressing and storing Air** by means of the waves of the sea, and for the generation of Electricity by means of this compressed air. The inventor considers that the vessel can be used as a telegraph ship, and is capable of being moored in 1000 fathoms of water, and connected with the shore at any distance with an electric telegraph cable.
Exhibited by C. W. HARDING, Assoc.M.Inst.C.E.

APRIL 18th, 1883.

JOHN KNOX LAUGHTON, M.A., F.R.A.S., F.R.G.S., President, in the Chair.

THOMAS GILBERT BOWICK, Stafford Lodge, Bedford;
EDWARD CLIFTON, F.R.G.S., F.R.H.S., Clifton House School, St. Neot's;
HENRY CULLEY, Cossey Mills, Norwich;
WILLIAM DOBERCK, Ph.D., M.R.I.A., Director of the Observatory, Hong Kong;
ALFRED NAYLOR PEARSON, A.I.C., F.C.S., Meteorological Office, Colaba, Bombay;
HENRY ROBINSON, M.Inst.C.E., 7 Westminster Chambers, S.W.; and
JOHN EDWARD WORTH, Assoc.M.Inst.C.E., Burslem,
were balloted for and duly elected Fellows of the Society.

The following Papers were read, viz.:—

"ON CIRRUS AND CIRRO-CUMULUS." By the Hon. F. A. ROLLO RUSSELL, M.A., F.M.S. (p. 147.)

"NOTES ON WATERSPOUTS; THEIR OCCURRENCE AND FORMATION." By GEORGE ATTWOOD, Assoc.M.Inst.C.E., F.G.S. (p. 159.)

"RECORD OF BRIGHT SUNSHINE." By W. W. RUNDELL, F.M.S. (p. 166.)

"NOTE ON WIND, CLOUDINESS, AND HALOS." By E. T. DOWSON, F.M.S. (p. 171.)

"NOTE ON RESULTS DERIVED FROM A 'REDIER' BAROGRAPH." By E. T. DOWSON, F.M.S.

AT the Meeting of the Society on the 21st of April, 1875, Mr. Symons, F.R.S. described the Barograph by Redier of Paris,[1] but I believe that no results from one of these instruments have yet been made public in this country. A "Redier" Barograph was tested for me at Kew, in February 1882, and its curves were found to correspond very closely with those of the photographic Barograph, and since it has been at Geldeston it has more than borne out the good character which it received from Mr. Whipple. Such being the case, I am led to hope that some results may be of interest.

The pressure scale of my instrument gives 4 ins. for each of the 3 barometric ins., and the time scale, in accordance with that of the Meteorological Office Barographs, is 8·75 ins. for twenty-four hours. The papers are renewed between 8 a.m. and 9 a.m. on every third day, when the clocks are wound-up, and the pencil is then set to the reading of the standard barometer corrected for temperature and altitude: and the curves, therefore, run accordingly. No correction has been applied to the curves themselves except for any error in the actual setting of the pencil at the commencement.

In most curves the extreme variation, from the greatest *plus* to the greatest *minus* error, had not exceeded ·02 in. or ·025 in. and occasionally it had been less than this, while on the other hand it has sometimes amounted to about ·03 in. As a rule the pencil tends to run too low with a rising, and too high with a falling barometer. These errors are found, however, on the mean nearly to cancel one another, and a comparison between the means of the 9 a.m. and 9 p.m. readings of the standard barometer and the means of the curves at the corresponding hours shows that in no month has the difference at these hours reached ·005 in., and that the mean error of the ten months at both 9 a.m. and 9 p.m. is —·002 in.; only on one occasion did any of the clocks stop, and throughout the whole series merely two hourly readings have been interpolated.

On comparing the hourly "differences from the mean" it is interesting to

[1] *Quarterly Journal*, Vol. II. p. 412.

TABLE showing results of Hourly Readings derived from a Redier Barograph at Geldeston.

1882.	1 a.m.	2 a.m.	3 a.m.	4 a.m.	5 a.m.	6 a.m.	7 a.m.	8 a.m.	9 a.m.	10 a.m.
	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.
March ..	29·961	29·959	29·952	29·948	29·949	29·950	29·955	29·963	29·969	29·976
April	29·765	29·765	29·763	29·761	29·765	29·770	29·776	29·780	29·785	29·791
May	30·048	30·044	30·040	30·038	30·043	30·046	30·049	30·056	30·058	30·057
June	29·871	29·864	29·863	29·862	29·865	29·868	29·871	29·874	29·880	29·882
July	29·848	29·844	29·841	29·841	29·846	29·851	29·857	29·862	29·862	29·862
August ..	29·882	29·875	29·868	29·866	29·865	29·867	29·867	29·869	29·873	29·873
September	29·853	29·848	29·841	29·836	29·836	29·838	29·840	29·842	29·844	29·845
October ..	29·830	29·832	29·826	29·827	29·827	29·826	29·831	29·833	29·837	29·840
November	29·625	29·622	29·615	29·609	29·609	29·613	29·620	29·634	29·646	29·651
December	29·640	29·641	29·641	29·639	29·635	29·632	29·633	29·639	29·649	29·655
Means ..	29·832	29·829	29·825	29·823	29·824	29·826	29·830	29·835	29·840	29·843
Diff. from Mean	—·003	—·006	—·010	—·012	—·011	—·009	—·005	·000	+·005	+·008

1882.	11 a.m.	Noon.	1 p.m.	2 p.m.	3 p.m.	4 p.m.	5 p.m.	6 p.m.	7 p.m.	8 p.m.
	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.
March ..	29·979	29·976	29·972	29·965	29·961	29·958	29·959	29·965	29·974	29·978
April	29·791	29·788	29·786	29·781	29·776	29·771	29·766	29·766	29·767	29·771
May	30·055	30·052	30·048	30·047	30·046	30·045	30·047	30·049	30·053	30·061
June	29·885	29·885	29·882	29·882	29·878	29·876	29·873	29·872	29·872	29·872
July	29·862	29·861	29·857	29·853	29·850	29·845	29·841	29·842	29·845	29·848
August ..	29·873	29·874	29·873	29·872	29·869	29·869	29·869	29·871	29·873	29·880
September	29·844	29·843	29·842	29·841	29·839	29·839	29·842	29·845	29·852	29·858
October ..	29·835	29·828	29·820	29·813	29·812	29·815	29·819	29·827	29·831	29·833
November	29·656	29·653	29·650	29·646	29·649	29·650	29·652	29·650	29·647	29·644
December	29·654	29·650	29·641	29·637	29·639	29·641	29·641	29·642	29·645	29·646
Means ..	29·843	29·841	29·837	29·834	29·832	29·831	29·831	29·833	29·836	29·839
Diff. from Mean	+·008	+·006	+·002	—·001	—·003	—·004	—·004	—·002	+·001	+·004

1882.	9 p.m.	10 p.m.	11 p.m.	Mid-night.	Mean.	Max.	Min.	Difference from Mean of Standard. 9 a.m.	9 p.m.
	In.	In.	In.	In.	In.	In.	In.	In.	In.
March	29·982	29·983	29·985	29·984	29·967	30·620	28·820	·000	+·001
April	29·772	29·769	29·768	29·768	29·773	30·410	28·950	—·003	—·001
May	30·069	30·070	30·070	30·070	30·053	30·480	29·320	+·002	—·001
June	29·878	29·875	29·870	29·867	29·874	30·360	29·350	—·001	—·002
July	29·853	29·857	29·857	29·855	29·852	30·470	29·315	·000	—·003
August	29·882	29·882	29·879	29·877	29·873	30·265	29·120	—·002	—·004
September	29·858	29·859	29·856	29·854	29·846	30·395	29·200	—·003	—·003
October	29·836	29·836	29·836	29·836	29·829	30·510	28·740	—·005	—·004
November ...	29·639	29·637	29·636	29·632	29·637	30·090	29·065	—·004	—·002
December	29·646	29·646	29·642	29·638	29·642	30·335	28·955	—·003	—·002
Means	29·842	29·841	29·840	29·838	29·835	..	..	—·002	—·002
Diff. from Mean	+·007	+·006	+·005	+·003	..	..	..	..	..

observe that at this station (nine miles from the sea) the minimum in the morning is decidedly more pronounced than that in the afternoon.

Since each three day curve, when complete, only requires the application of a correction for the pencil error above mentioned (any correction for the variations in the temperature of the mercurial column in this case being very small, and like that for the effect of humidity on the cord, unknown), the hourly readings are rapidly tabulated. This is effected by means of a glass scale graduated to ·01 in., and the readings are taken to the nearest ·01 in. except in cases where the trace runs exactly intermediate, such as 29·945 in., which is entered as 29·945 in.

On the system above described the results given in the foregoing table (p. 181) were obtained.

Mr. WHIPPLE remarked that a good deal of the accuracy of this, and several other mechanical barographs, depended upon the exactness with which the registration papers were ruled, cut, and fitted to the instrument.

Mr. STRACHAN considered that the one great fault of self-recording instruments was the badness of the clocks.

Dr. TRIPE said that he had sometimes found the pencils attached to self-recording instruments a source of error, as they often pierced and stuck in the paper and stopped the whole apparatus.

Mr. SYMONS had used a Redier Barograph with thorough satisfaction for 6 or 7 years, and had never experienced any difficulty with the pencil. As the maker happened to be a clockmaker rather than an optician, the clock had kept in good order. He thought that opticians would act more wisely by buying their driving clocks from clockmakers of high standing, than by allowing their own men to make them, and quoted some facts in support of this contention.

Mr. LECKY referred to a pencil such as those used by Messrs. Tinsley Brothers, in which glycerine in distilled water mixed with some aniline dye was used, the point of the capillary glass tube being made round and smooth in a gas flame so as to travel over the paper almost without friction, the fluid used never becoming dry in the point of the pen.

Mr. CURTIS said he could testify to the great care Mr. Dowson had taken to get his barograph forms accurately drawn and printed. He thought the very satisfactory result Mr. Dowson had obtained, as shown by his remarkably small residual error, was largely due to the interest he took in everything connected with the working of the instrument. Referring to the siphon pen mentioned by Mr. Lecky, he said he had used such pens a good deal, and had always found them most satisfactory; they were extremely light, produced a fine trace, were very reliable, and worked with scarcely any friction whatever.

Mr. DOWSON, who was unable to be present at the meeting, in a note to the Secretary stated that the accuracy of the Barograph results in no way depended on the exactness of the cutting of the papers, inasmuch as the edges were not used as a guide for the purpose of winding the papers truly on the cylinder. The plan adopted was to fix the pencil on the central, or 29·50 in. line, and then to wind the cylinder while holding the paper by the hand, so that the pencil followed that line all the way down the form; and with care no error exceeding ·002 in. on either side of the line would occur. The pencil used was a "Solid Ink Pencil," and it worked well and easily.

"THE COLD WEATHER OF MARCH 1883." By WILLIAM MARRIOTT, F.M.S. (See *Meteorological Record*, Vol. III. p. 4.)

CORRESPONDENCE AND NOTES.

The Meteorology of Cyprus.

Dr. F. W. Barry, the late Sanitary Commissioner for the Government of Cyprus, in his Annual Reports for 1880 and 1881, gives the results from a few meteorological stations which he had organised in the Island. The only previous observations were those taken at Larnaca for 1867-71, by Mr. T. B. Sandwith, H.M. Vice-Consul for Cyprus, and the records of which are published in the *Journal of the Scottish Meteorological Society*. Dr. Barry has organised five stations, viz. Nikosia, Famagusta, Larnaca, Papho and Kyrenia; the instruments being supplied by the Meteorological Council.

Nikosia, owing to its inland position, has the highest mean temperature and also the greatest range, having a mean temperature of 67°, a mean range of 26°·5, and an absolute range of 82°·5. Larnaca has a mean temperature of 67°·7, a mean daily range of 25°·5, and an absolute range of 72°. Papho has a mean temperature of 67°·2, a mean range of 15°·4, and an absolute range of 68°. The highest recorded temperature in the shade occurred at Nikosia on the 27th August, when 111° was registered. The lowest temperature was recorded at the same place on the 17th February, when the thermometer fell to 28°·5.

The accompanying Table gives the absolute and mean maximum and minimum temperature at Larnaca for 1867-71 and 1881; and also the rainfall for 1881:—

Month.	1867-71.						1881.							
	Temperature.						Temperature.						Rainfall.	
	Absolute Max.	Absolute Min.	Range.	Mean Max.	Mean Min.	Mean.	Absolute Max.	Absolute Min.	Range.	Mean Max.	Mean Min.	Mean.	Total.	Days.
	°	°	°	°	°	°	°	°	°	°	°	°	In.	
January	67·1	38·5	28·6	62·3	43·4	52·9	76·0	37·0	39·0	69·0	48·5	58·7	2·400	9
February	70·3	36·1	34·2	60·0	41·8	50·9	70·5	35·0	35·5	65·9	46·2	56·0	4·084	6
March ..	73·0	40·7	32·3	66·4	48·8	57·6	76·0	36·0	40·0	66·8	44·6	55·7	1·053	3
April	70·5	41·2	29·3	69·6	49·7	59·6	85·8	40·0	45·8	75·1	47·9	61·5	·400	5
May	89·3	56·7	32·6	79·4	62·7	71·1	88·2	44·0	44·2	83·1	53·2	68·1	1·034	2
June	105·0	..	..	90·6	..	..	97·5	..	..	86·7	..	..	..	0
July	94·3	65·0	29·3	89·7	71·1	80·4	95·0	61·0	34·0	89·9	72·9	81·4	·020	1
August ..	96·0	68·5	27·5	89·3	73·3	81·3	107·0	60·0	47·0	95·8	71·7	83·7	..	0
September	90·0	65·0	25·0	85·6	69·2	77·4	101·0	54·0	47·0	91·1	67·2	79·1	..	0
October ..	78·6	47·0	31·6	80·4	54·4	67·4	103·5	53·0	50·5	90·0	58·9	74·4	·015	1
November	81·8	41·0	40·8	69·6	52·0	60·8	100·0	45·0	55·0	80·1	50·2	65·1	1·163	8
December	63·5	40·5	23·0	60·4	48·4	54·4	76·0	37·0	39·0	72·4	44·1	58·2	1·260	4
Year....	105·0	36·1	68·9	75·3	55·9	65·6	107·0	35·0	72·0	80·5	55·0	67·7	11·429	39

Rain was recorded at seven stations. The total fall registered was highest at Famagusta, 22·467 ins., while the lowest was recorded at the Auditor and Accountant General's Office at Nikosia, 9·547 ins. The total fall at Kyrenia was 18·313 ins., at Papho 16·005 ins., and at Larnaca 11·429 ins. Rain fell on the greatest number of days in Kyrenia, 69, and the least at Larnaca, 39. The greatest amount registered in one day was at Papho on January 12th, 2·60 ins.

Dr. Barry says that there can be no doubt that the rain registered in the plains represents a very small amount of that which falls in the Island, and it is to be hoped that in the next year's report it will be possible to give records of the rainfall at Machera, Government House, Troodos and Rhizo Karpass, where gauges have been placed.

RECENT PUBLICATIONS.

ANNUAIRE DE LA SOCIÉTÉ MÉTÉOROLOGIQUE DE FRANCE. 31me Année. 1883. Janvier-Février. 4to.

Contains :—Un nouveau thermomètre destiné à mesurer la température du sol, par Dr. Hamberg (2 pp.).—De l'action du froid sur les végétaux pendant l'hiver 1879-80, par M. C. Baltet, horticulteur à Troyes. Rapport de M. E. Renou (2 pp.).—Manuel de la prévision du temps à Bar-le-Duc, par M. Poincaré (9 pp.). —Note sur la trombe d'eau observée à Cannes, le 27 Octobre 1882, par M. Reynaud (2 pp.).

ASSOCIAZIONE METEOROLOGICA ITALIANA. BOLLETTINO MENSUALE PUBBLICATO PER CURA DELL' OSSERVATORIO CENTRALE DEL REAL COLLEGIO CARLO ALBERTO IN MONCALIERI. Serie II. Vol. III., Nos. 1-2, January-February 1883. 4to.

Contains :—Relazione della inondazione nella Provincia di Rovigo causata della rota dell' Adige a Legnago avvenuta il 18 Septembre 1882, del Prof. D. G. Federspiel (3 pp.).—Notizie sull' uragano de 20 Ottobre 1882 all' Isola di Manilla nelle Filippine (6 pp.).—Piogge ed Inondazioni nel Tortonese e nei Dintorni, del D. P. Maggi (1 p.).—Instruzioni per le osservazioni eliofotometriche, del Prof. F. Craveri (3 pp.).

ASTRONOMISCHE, MAGNETISCHE UND METEOROLOGISCHE BEOBACHTUNGEN AN DER K. K. STERNWARTE ZU PRAG IM JAHRE 1882. Auf öffentliche Kosten herausgegeben von Dr. G. GRUSS. 43 Jahrgang. 80 pp. 4to. 1883.

In addition to the usual magnetical and meteorological results, this also contains a Table giving the monthly seasonal and yearly means of the barometer for the forty-three years 1840-82.

BEHM'S GEOGRAPHISCHES JAHRBUCH. Vol. IX. 8vo. 1883.

Contains :—Bericht über die Fortschritte der geographischen Meteorologie, von Dr. J. Hann (72 pp.). This biennial report gives an account of all the papers that have been published on Meteorology during the two years 1880 and 1881.

BOLETIN DA SOCIEDADE DE GEOGRAPHIA DE LISBOA. 8A Serie. No. 11. 8vo. 1882.

This contains a paper on the Island of Sal, one of the Cape Verd Islands (34 pp.), which gives tables showing the results of meteorological observations made daily at 9 a.m. and 3 p.m. from October 1862 to March 1866. The mean annual temperature is 78°·3. The maximum temperature during the period, 95°·4, occurred on October 11th, 1864, and the minimum, 64°·9, on February 10th of the same year. The general direction of the wind is East-north-east.

BOLETIN DE LA SOCIEDAD GEOGRAPHICA DE MADRID. Tomo XIV. No. 4. April 1883. 8vo.

Contains a paper entitled "Observacion de las tempestades" (4 pp.).

CIEL ET TERRE. Revue Populaire d'Astronomie, de Météorologie et de Physique du Globe. Vol. IV. Nos. 5-10, May-July 1883. 8vo.

Contains :—L'Aurore boréale, par E. Lagrange (9 pp.).—La théorie des orages et des grains, par J. Vincent (9 pp.).—La Saint-Médard, par A. Lancaster (9 pp.).—Etude sur les courants de l'Escant et de la Durme, par A. Lancaster (10 pp.).

HOLIDAY NUMBER OF THE LONDON MEDICAL RECORD. July 15th, 1883. 8vo. 54 pp.

This contains a great deal of information respecting some of the English and foreign health-resorts, and useful hints to travellers. Among the papers may

be mentioned :—Continental climatic resorts in summer, by Dr. H. Weber (4 pp.).—The choice of English health-resorts, by Dr. E. S. Thompson (3 pp.).—Seaside resorts on the French coast, by Dr. Vintras (6 pp.).—Pyrenean and adjacent summer health-resorts, by Dr. J. B. Yeo (5 pp.).—Llandudno, by Dr. J. Nicol (7 pp.).

INDIAN METEOROLOGICAL MEMOIRS: being occasional Discussions and Compilations of Meteorological Data relating to India and the Neighbouring Countries. Published under the direction of HENRY F. BLANFORD, F.R.S., Meteorological Reporter to the Government of India. Vol. II. Part I. (78 pp.). 4to. 1882.

This part contains two papers, viz. (1) Account of the South-west Monsoon Storm of the 18th to the 24th of September 1878 in the North of the Bay of Bengal, by John Eliot, M.A. (71 pp. and 9 plates). The extensive storms, usually called cyclones, are of comparatively rare occurrence, more especially in the Northern half of the Bay. The smaller storms, of which the one discussed is a typical example, are very common during the rains; several of greater or less intensity occurring each year during the months of June to October.—(2) List of Cyclones on the West coast of India and in the Arabian Sea up to the end of the year 1881, compiled by F. Chambers, (6 pp.). Storms are far more frequent in June than in any other month of the year, and May, November and April follow each other in order of frequency. There is no month entirely free from storms. It also appears that the storms of the Arabian Sea are, on the whole, much more frequent in the years of many sun-spots than in those of few spots.

MEMORIE DELLA R. ACCADEMIA DI SCIENZE, LETTERE ED ARTI DI MODENA. Vol. II. Ser. II.; Sezione di Scienze. 4to. 1883.

Contains a paper by Prof. D. Ragona, entitled, Andamento annuale della pressione atmosferica (127 pp. and 4 plates). This is an investigation into the annual range of atmospheric pressure at Modena; the observations employed extending from 1864 to 1881.

METEOROLOGICAL OBSERVATIONS MADE AT THE ADELAIDE OBSERVATORY DURING THE YEAR 1880, under the direction of CHARLES TODD, C.M.G., F.R.A.S. Foolscap folio. 380 pp. 1882.

In addition to the usual observations for Adelaide, this contains tables showing the mean pressure and temperature of the air for each month and year from 1857 to 1880, and the rainfall from 1839 to 1880. Abstracts of meteorological results are also given from thirteen stations, as well as the monthly rainfall from 172 stations in various parts of the colony.

PROCEEDINGS OF THE ROYAL INSTITUTION OF GREAT BRITAIN. Vol X. Part I. No. 75. 8vo. 1883.

Contains:—Climate in Town and Country, by Prof. E. Frankland, F.R.S. (11 pp.). The author observes that the chief things affecting climate are: 1, the sun; 2, land and water—ocean and atmospheric currents; 3, aspect—slope of ground, exposure or shelter; 4, nature of surface; 5, reflection from land and water; 6, rain and clouds—suspended matter in the air; 7, latitude—incidence of solar rays, thickness of air; and 8, pressure or absence of aqueous vapour. Genial climate is ultimately resolvable into two prime factors—sun-warmth and air-warmth. The amount of sun-warmth depends upon the length of and the quantity of suspended matter and aqueous vapour in the air. The warmth of the air depends upon contact with matter heated by the sun's rays, and upon the stoppage of radiation from the earth by aqueous vapour.

RAINFALL TABLES OF THE BRITISH ISLES FOR 1866-1880. Compiled from the Records of 366 Stations, by G. J. SYMONS, F.R.S. Published by the Authority of the Meteorological Council. Official, No. 47. 8vo. 1883. 199 pp.

This is a most valuable contribution to the Climatology of the British Isles. The Tables contain the monthly and annual totals of rainfall for the 366 stations

for each of the fifteen years 1866-80, as well as the means for each five years and for the whole period. The geographical position of the stations is shown by three maps, which also exhibit the river basins in which they are respectively situated.

REPORT OF OBSERVATIONS OF INJURIOUS INSECTS DURING THE YEAR 1882, with Methods of Prevention and Remedy; and Special Report on Wireworm. By ELEANOR A. ORMEROD, F.M.S. 1883. 98 pp. 8vo.

The season of 1882 was, on the whole, free from wide-spread attacks of insects occurring to any greatly injurious extent, with the exception of those of Aphides, which were the cause of serious loss, amounting to little less than devastation of the hop crops. The chief attacks were those of Apple Weevil on the apple blossom in the spring, and some bad cases of local injury from Daddy-longlegs grubs; and later on the caterpillar of the Winter Moth did much harm to leafage. Wireworm caused much havoc in a few localities, but not as a general pest; and there were also local attacks of Clover, Pea and Turnip Weevils, causing much loss to the respective crops; the brunt of the year's attack, however, fell on the hops.

RESULTS OF THE MAGNETICAL AND METEOROLOGICAL OBSERVATIONS MADE AT THE ROYAL OBSERVATORY, GREENWICH, IN THE YEAR 1881; under the direction of SIR G. B. AIRY, K.C.B., and W. H. M. CHRISTIE, M.A., F.R.S. 1883. 4to. 121 pp.

The introduction, containing a description of the buildings, instruments, &c. has been completely rewritten for this volume. In addition to the usual magnetical and meteorological results, there are also tables showing the mean monthly reading of the barometer, dry and wet bulb thermometers, dew-point, and relative humidity, at every hour of the day; the total amount of sunshine registered in each hour of the day in each month, the daily readings of thermometers at 25·6 ft., 12·8 ft., 6·4 ft, 3·2 ft. and 1 in. below the surface of the soil, the mean hourly velocity of the wind, and the mean hourly electrical potential of the atmosphere in each month.

SOCIEDADE DE GEOGRAPHIA DE LISBOA—EXPEDIÇÃO SCIENTIFICA Á SERRA DA ESTRELLA EM 1881. Secção de Meteorologia. Relatorio do Sr. A. C. Da Silva. 77 pp. and 10 plates. 4to. 1883.

In connection with the scientific expedition to the summit of the Serra da Estrella, 6070 feet above sea level, hourly meteorological observations were made each day from the 5th to the 19th of August, 1881. The present report contains a full description of the instruments, and the observations in detail.

SYMONS'S MONTHLY METEOROLOGICAL MAGAZINE. Vol. XVIII. Nos. 208-210, May-July 1883. 8vo.

Contains:—The Temperature of the Thames (3 pp.).—An Artificial Aurora (4 pp.).—Globe Lightning (1 pp.).—True Time (9 pp.).—A "Lightning Figure" photographed (4 pp.).

THE NORWEGIAN NORTH-ATLANTIC EXPEDITION 1876-1878. METEOROLOGY, by H MOHN. Folio. 150 pp. 18 woodcuts, 8 plates and 1 map. 1883.

The scheme of meteorological work for this expedition comprised hourly observations of the direction, force and velocity of the wind, the pressure, temperature and humidity of the atmosphere, the form and amount of cloud, the nature and amount of precipitation, the direction and state of the sea, the temperature of the sea-surface, and phenomena of occasional occurrence. In this memoir Dr. Mohn first describes the instruments employed and the mode of using them, as also the reduction of the observations; he then tabulates the reduced values, and sets forth the results deduced therefrom. In an appendix he gives his observations on the evaporation of sea-water.

THE QUARTERLY WEATHER REPORT 1880. Appendices and plates. Published by the authority of the Meteorological Council. 18 pp. and 73 plates. 4to. 1883.

Appendix II. contains a report on experiments made at the Kew Observatory with thermometer screens of different patterns during 1879, 1880, and 1881, by G. M. Whipple. The object of these experiments was to compare the effect upon temperature of thermometer screens generally used in this country with that of the pattern devised by Dr. H. Wild for use at the Russian stations. The results show that the mean daily temperature given by a thermometer in a Stevenson screen only differs from that indicated by a thermometer in a Wild's screen by 0°·1, and from that given by the thermograph by 0°·4. The greatest differences between the readings of the thermometers in the different screens are found to exist in calm weather and in autumn. In windy weather the differences are very small.

THE TRANSACTIONS OF THE SOUTH AFRICAN PHILOSOPHICAL SOCIETY. Vol. II. Part III. 1880-1881. 8vo. 1882.

Dr. D. Gill, in his Presidential Address, gives an account of the present state of Meteorology in the colony.—Mr. J. G. Gamble also contributes a paper on Summer and Winter Temperature in South Africa (5 pp.).

TRANSACTIONS OF THE SANITARY INSTITUTE OF GREAT BRITAIN. Vol. IV. Congress at Newcastle-upon-Tyne. 1882-3. 8vo. 1883. 352 pp.

The Address (12 pp.), by Dr. A. Mitchell, Chairman of the Chemistry, Meteorology and Geology Section, was intended to show that the relations of weather to the distribution of deaths from certain diseases has now been so definitely ascertained, in so far as regards this country, that no account of these diseases can be regarded as complete which fails to treat of those relations. The Hon. F. A. Rollo Russell also read a paper on "The Improvement of Climate with slight Elevation" (10 pp.).

TRANSUNTI DELLA REALE ACCADEMIA DEI LINCEI. Serie 3. Vol. VII. 4to.

Contains two papers by Paolo Busin, viz. (1) Misura della altezze mediante il barometro (2 pp.); and (2) Sin tipi isobarici italiani (4 pp.).

TRAVAUX DE L'ASSOCIATION DES SOCIÉTÉS SUISSES DE GÉOGRAPHIE dans sa Deuxième Session à Genève les 29, 30 et 31 Août 1882. 8vo. 1883. 206 pp.

Contains the following meteorological articles:—L'importance des forêts en égard à la quantité et à la distribution des eaux, par H. B. de Beaumont (9 pp.).—La grêle et ses relations avec les forêts et la configuration du sol, d'après les observations faites en Argovie, par M. Riniker (12 pp. with map).—Essai de climatologie helvétique, par Dr. E. Dufresne (13 pp.).

ZEITSCHRIFT DER OESTERREICHISCHEN GESELLSCHAFT FÜR METEOROLOGIE. Redigirt von Dr. J. HANN. XVIII. Band. May-July 1883. 8vo.

Contains:—Die gestrengen Herren, von Dr. van Bebber (5 pp.).—Ein Beitrag zur Klimatologie der schwäbisch-bairischen Hochebene, von Dr. C. Lang (7 pp.).—Die Entstehung der Cyklonen, von Dr. P. Andries (6 pp.).—Höhenbestimmung die Wolken aus der Zeit der Beleuchtung vor Sonnenauf-oder nach Sonnenuntergang, von Dr. Vettin (3 pp.).—Die meteorologischen Beobachtungen am Bord des Polarschiffes "Tegetthoff" unter Carl Weyprecht, in den Jahren 1872-74, von Vice-Admiral B. v. Wüllerstorf-Urbair (7 pp.).—Die Untersuchungen über Gewitter in Baiern und Württemberg, von W. v. Bezold (7 pp.).—Ueber die Grösse der täglichen Wärmeschwankung in ihrer Abhängigkeit von den Localverhältnissen, von Dr. A. Woeikoff (18 pp.).

QUARTERLY JOURNAL

OF

THE METEOROLOGICAL SOCIETY.

VOL. IX. No. 48.

COMPOSITE PORTRAITURE ADAPTED TO THE REDUCTION OF METEOROLOGICAL AND OTHER SIMILAR OBSERVATIONS.

By G. M. WHIPPLE, B.Sc., F.R.Met.Soc., F.R.A.S., Superintendent of the Kew Observatory, Richmond.

[Read May 16th, 1883.]

IT has often been remarked that one of the main, if not the chief, of the difficulties the meteorologist has to contend with, is the enormous amount of preliminary labour which has to be expended in the not very pleasing task of forming the observations he may wish to discuss into tables, casting the columns of figures so obtained, and then computing the means. Should, as in many cases now-a-days, his original material be in the shape of curves, *e.g.* barograms, thermograms or anemograms, he has first to reduce these to figures by tabulation, before he can attempt any step towards their reduction.

The deterrent nature of these preliminary operations not unfrequently forms a complete bar to the entering upon most interesting investigations with the view to the advancement of the science, in the case of persons unable to devote sufficient time to such labour, which may almost be termed drudgery. To cite examples, a glance at the recently published papers in the Proceedings of the Royal Society, by Professor Balfour Stewart and by Mr. C. Chambers, in which they endeavour to trace a possible intimate connection between solar and terrestrial phenomena, will show the immense amount of calculation they had to perform in order to arrive at their results—how, for instance, preliminary means had to be taken of three days' observations and the result assumed to be a corrected value of the middle day of the three, then after the whole series had been so treated, a second or even a third set of three-day averages computed. The author has also a lively recollection of

the excessively tedious calculations required to eliminate in a somewhat similar manner the effect of disturbances in the discussion of the Kew magnetic results for the late Sir E. Sabine. With the view of arriving at results by a shorter cut, the author has been led to consider the possibility of employing a method suggested by an examination of the highly ingenious system of composite portraiture invented by Mr. Francis Galton, F.R.S., and utilised in his anthropological studies.

Mr. Galton's method of experiment is based upon the fact that certain groups of people possess certain physiognomical features in common. This agreement of feature is usually characterised by the term "family likeness." In order, therefore, to select this particular element from the others, and to obtain a picture in which it is most strongly defined; or, in other words, to form a characteristic portrait of the group of individuals, Mr. Galton employs a series of photographs. These, representing a large number of men or women, are first reduced to the same scale, and then projected successively upon a sensitised photographic plate, having been previously so arranged that the eyes or other salient feature shall always fall on the same portion of the plate.

In this manner a negative is eventually obtained which gives a print depicting a countenance which, although resembling but partially any one of the component portraits, gives a fair typical picture of the group of individuals. Among other results Mr. Galton has detected the likeness existing in various classes of criminals, and also in patients suffering from the same disease, as well as the more marked features transmitted through the different members of a family.

Since in meteorological investigations the desire is to select and to identify the one particular variable running through a group of phenomena, it has appeared to the author, arguing by analogy, feasible to perform this operation by a method somewhat resembling that just described. Supposing, for example, it is desired to determine the true curve of diurnal variation of the wind velocity at any given station. In the case of proceeding by the ordinary routine of hourly sums and means, it will be found that the occurrence of a high wind or gale on a single day will vitiate the results for a considerable period of time.

If, on the other hand, instead of doing this, a drawing or photograph be made on one sheet of the daily curves for a few weeks, it will be found that the traces for the days free from storms will lie so fairly close together or upon one another, that little difficulty will be found in selecting or drawing through them a curve representing the general run of the group. Several sets of curves having been so treated, the typical curves must be in turn themselves superimposed, and through them another curve drawn, which will be still less affected by abnormal movements; so eventually the true curve of diurnal variation would be arrived at.

In the case of subjecting photographic traces, *e.g.* barograms, thermograms, electrograms, magnetograms, &c. to this treatment, it would be advisable to employ negatives instead of the original curves, in order that

the composite produced might consist of dark lines on a white background; not the reverse, which would be comparatively useless for the purpose.

For the reduction of anemograms, rain, and sunshine curves, by this method, it will be necessary to make drawings or tracings first from the curves, giving the hourly values separated, as is done in the diagrams published in the *Quarterly Weather Reports* of the Meteorological Office and in the Kew *Times* curves.

Another application of the method of composite drawing will serve to facilitate the acquisition of a knowledge of the general distribution of weather systems over large tracts of the Earth's surface. To do this a series of weather charts should be taken, and selecting certain prominent features, such as the centres of cyclonic and anticyclonic disturbances, day by day their positions should be marked off upon one chart. This being done in a sufficient number of cases and combined, a repetition of the process would enable a determination to be made of the average distribution of these systems for a given season.

The author has attempted to illustrate his proposed applications of the method of composite portraiture by three examples. The data treated in every case were chosen at random, and may therefore be considered as indicating the applicability of the process to meteorological work in general.

In the first example the mean diurnal variation in the wind velocity at the Kew Observatory, Richmond, was determined for three months—August to October, 1879. Taking the hourly values of the rate at which the wind was blowing, from the Meteorological Office publications, curves were plotted down on a conveniently open scale, a fortnight on a sheet. Through the fourteen curves drawn in pencil a mean curve was traced in red. This roughly represented the average daily movement for a fortnight.

The pair of fourteen-day curves being superimposed on a third sheet, a third trace drawn between them was assumed to be the mean trace for the month, and finally combining the three so derived months' traces, it was easy to draw a final curve showing the mean diurnal variation of wind velocity during the quarter in question.[1]

The second experiment was an attempt to obtain a monthly mean of the barometer directly by the graphic method. Taking advantage of a self-registering aneroid being on trial, its traces were utilised for the month, January 8th to February 7th, 1883. These were copied off on a sheet of tracing paper, ruled so as to comprise one day's curve only. The tracing paper was then folded vertically, so as to compress the curves, and the mean positions of the traces were drawn on the folds. After four foldings a point was fixed upon as the mean of the month, and the value of this point referred to the scale of the instrument. The resulting value for the mean barometric pressure of

[1] It must be remarked that a due proportion should be preserved between the scales of the ordinates and abscissæ, for unless this is done the combined traces may appear merely as a mass of confused lines. Such was the case in one experiment made by the author, when he attempted to derive the curves directly from the zinc templates engraved at the Meteorological Office, and kindly placed at his disposal by Mr. Scott.

the month very satisfactorily agreed with the value determined by calculation from the barometer readings taken daily at the Observatory.

The third series of illustrations represented the positions of the centres and the contours of the areas of maximum and minimum barometric pressure over the Atlantic during January, February, and March, 1881. A number of blank charts were worked off by the chromograph, on tracing paper, to the scale of the International Synchronous Charts. Tracings were made on one sheet in blue pencil of the cyclonic centre for each day of the month, and a similar set of tracings in red of the anticyclonic centres. Having from these drawn the mean positions and areas of the systems for the month, it was easy to draw another chart with the general distribution for the quarter. These diagrams were seen on comparison to differ materially from those drawn for the monthly means of the observations. In suggesting the composite method of treatment of meteorological data, the author is fully aware that a somewhat similar process has been already applied in the determination of the radiant points of shooting stars, and would also desire to state that the process is not by him considered as equalling or even approximating in accuracy that of employing the Harmonic Analyser in computing the periodical variations of the elements. As, however, that instrument is not at the command of many investigators, he is of opinion that the labour of reduction may in many cases be saved by making use of the graphic or composite, instead of the purely numerical method.

DISCUSSION.

Mr. STRACHAN said that the chief object of the paper appeared to be to arrive at means, but there was no need to draw curves so elaborately for such a purpose. The Harmonic Analyser had been referred to in the paper, but he had yet to learn what the capabilities of that instrument were, and also its degree of accuracy. Some information as to the mode and cost of working the instrument would also be interesting.

Mr. SCOTT remarked that by using the Harmonic Analyser all tabulations might be done away with, and that the curves might be passed through the instrument without being subjected to any measurement. A comparison had recently been made with thermograms between the results derived from hourly tabulations and those given by the Harmonic Analyser on the data for the year 1876, and from this comparison the Meteorological Council were satisfied that the action of the Harmonic Analyser was correct, as far as temperature was concerned.

Mr. CURTIS said, with regard to the working of the Harmonic Analyser, that as yet thermograms were the only curves with which much experience had been obtained, and the rate at which they could be passed through the instrument and the constants obtained was twelve months curves for one observatory in about twelve working days. Of course a good deal of practice in manipulating the instrument was necessary before this rate could be attained. As had been stated by Mr. Scott, a comparison of the instrumental results with others obtained by calculation had shown the working of the instrument to be very satisfactory.

Mr. SYMONS inquired in what form the results came out after passing the curves through the Harmonic Analyser.

Mr. SCOTT explained that the Harmonic Analyser gave values from the co-efficients of which the various terms of Bessel's formula could be at once obtained.

Mr. BAKER remarked that Mr. Whipple's idea was to throw out a suggestion as to a new way of treating observations, instead of relying exclusively upon means, and so far the results obtained by his method were fairly satisfactory.

Mr. C. HARDING inquired whether Mr. Whipple intended this method to do away with the necessity of making the tabulations; if so it was good, but if the tabulations were made it then became a very simple matter to obtain Bessel's harmonic curve, which gave the best possible results. He referred to Kaemtz "On the Deduction of Mean Results from Meteorological Observations," printed in the *Quarterly Journal*, Vol. III. p. 120.

Mr. BAKER, replying to Mr. Harding, said that Mr. Whipple's intention was to deal with the curves themselves and not with the tabulations of the hourly readings.

Mr. SCOTT remarked that the question was how many equidistant observations were requisite to represent the true daily curve. In general twenty-four hourly values were taken, but at Helsingfors for the space of thirteen years (1844-57) eye-readings at twenty minutes' intervals had been maintained. This, of course, entailed a prodigious amount of labour. In Mr. Simmonds' inquiry into the diurnal range of the barometer, which had been completed by Mr. Strachan and published in the *Journal*, stations giving two-hourly readings had been accepted. The Meteorological Council had, in order to test the point, instructed Mr. Strachan to calculate separately the constants for the even and the odd hours, and to compare the results with those obtained from the entire curve. He might say that the accordance was very satisfactory, so that the twelve readings per day would apparently suffice.

The PRESIDENT (Mr. LAUGHTON) thought the discussion had turned on the merits or demerits of the Harmonic Analyser, which the paper only incidentally referred to, rather than on the method of taking means, which it more distinctly suggested. He would remind the Fellows that Mr. Whipple proposed dealing with curves as curves, whether barogram, thermogram, or anemogram,—not with tabulated numbers: he took the curves as they were, and suggested a method of drawing a mean curve, without the excessive labour of the ordinary arithmetical process. Whatever might be the merits of the Harmonic Analyser, it was too costly and too complicated ever to have more than a very limited application.

NOTE ON ATMOSPHERIC PRESSURE DURING THE FALL OF RAIN. By H. SOWERBY WALLIS, F.R.Met.Soc.

[Read May 16th, 1883.]

IN the course of last year it occurred to me to ascertain the condition of atmospheric pressure while rain was falling. Mr. Symons kindly placed at my disposal the sheets of his barograph and recording rain-gauge, and I now lay the results of the inquiry before the Society.

During the year 1882, 27·14 ins. of rain fell at Camden Square on 165 days, but for the purposes of this inquiry all days on which only ·01 in. of rain fell have been discarded, and a few other days have been omitted owing to slight interruptions in the records of the rain-gauge and barograph. This reduced the available quantity to 26·17 ins. of rain, falling on 186 days.

The barograms and sheets of the recording rain-gauge were laid side by side, and from them I entered on a form—the amount of rain, the mean height of the barometer to the nearest twentieth of an inch while the rain was falling, and also whether atmospheric pressure was increasing, diminishing, or steady. Where rain fell continuously for some hours there was no difficulty in seeing whether the pressure meanwhile was increasing or diminishing, but with short sharp showers it was not easy; to overcome this I adopted as a minimum period three hours, taking the general condition of pressure for an hour and a half before and an hour and a half after the fall of rain.

Sometimes rain occurred at the crisis of a depression; the duration and quantity being equally divided between the diminishing and increasing pressure; in these cases, probably not exceeding half a dozen, the entry was made as a fall of rain with steady pressure.

The numerical results of the 186 rainy days dealt with are as follow:—

On 73 days or 54 per cent. the rain was accompanied by diminishing pressure.
„ 37 „ 27 „ „ „ increasing „
and „ 26 „ 19 „ „ „ steady „

Of the 26·17 ins. of rain dealt with—

16·20 ins. or 62 per cent. fell with diminishing pressure.
4·66 ins. „ 18 „ „ increasing „
and 5·31 ins. „ 20 „ „ steady „

	Ins.
The mean pressure (reduced to 32° and sea level) during rainfall for the whole period was	29·65
The mean pressure (reduced to 32° and sea level) during falls of rain occurring with diminished pressure was	29·63
„ „ „ increasing „	29·69
and „ „ „ steady „	29·69

The difference of atmospheric pressure from the mean of the whole period was in no case as much as one per cent.

A table of the above results for each month and for each quarter is appended.

The number of instances occurring in a quarter, much less a month, is too small to give a fair mean, but these means nevertheless show a general agreement with those for the whole year.

There were 18 days on which falls of rain occurred with a pressure of 30 ins. or upwards.

On 9 of these occasions or 50 per cent. the pressure was diminishing.
„ 4 „ 22 „ „ increasing.
and „ 5 „ 28 „ „ steady.

There were 83 days on which rain fell with a pressure ranging from 29·50 ins. to 29·95 ins. Of these—

42 falls or 51 per cent. occurred with diminishing pressure.
26 „ 31 „ „ increasing „
and 15 „ 18 „ „ steady „

The falls of rain when the pressure was between 29 ins. and 29·45 ins. were 35 in number.

22 or 63 per cent. occurred with diminishing pressure.
7 or 20 „ „ increasing „
and 6 or 17 „ „ steady „

These also are in fair agreement all through the scale, and with the mean for the whole year, the values being as follow:—

		Percentages of Pressure.		
		Diminishing.	Increasing.	Steady.
Whole range of the barometer	186 days	54	27	19
Pressures of 30·00 ins. & upwards	18 „	50	22	28
„ 29·50 ins. to 29·95 ins.	83 „	51	31	18
„ 29·00 ins. to 29·45 ins.	35 „	63	20	17

These figures seem to show that at low pressures rain more frequently occurs with the pressure diminishing than when it is accompanied by a high pressure.

Six falls of rain occurred during the year at pressures of 30·10 ins. and upwards, viz. :—

	In.	Ins.	Pressure.
March 11th.	·12	30·40	increasing.
July 27th	·08	30·35	steady.
Feb. 15th	·08	30·30	increasing.
Sept. 5th	·46	30·15	steady.
Oct. 2nd	·14	30·10	steady.
Feb. 18th	·09	30·10	increasing.

It is noteworthy that in none of these cases was barometric pressure decreasing during the continuance of the rain. No rain occurred with the pressure below 29·00 ins.

ATMOSPHERIC PRESSURE DURING THE FALL OF RAIN.

1882.	Number of Days of Rainfall.				Amount of Rain.				Mean Height of Barometer during Rain.			
	Pressure.			Total.	Pressure.			Total.	Pressure.			Mean.
	Diminishing.	Increasing.	Steady.		Diminishing.	Increasing.	Steady.		Diminishing.	Increasing.	Steady.	
					Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.
December	10	3	0	13	1·96	·39	·00	2·35	29·64	29·70	..	29·65
January	3	3	1	7	·38	·39	·56	1·33	29·95	29·77	29·85	29·86
February	3	3	0	6	·97	·31	·00	1·28	29·55	29·87	..	29·68
Winter ..	16	9	1	26	3·31	1·09	·56	4·96	29·68	29·77	29·85	29·71
March ..	2	6	2	10	·74	·53	·10	1·37	29·90	29·68	29·60	29·70
April	9	3	2	14	2·44	·32	·04	2·80	29·36	29·52	29·62	29·43
May	4	4	1	9	·54	·17	·42	1·13	29·58	29·80	29·90	29·71
Spring ..	15	13	5	33	3·72	1·02	·56	5·30	29·49	29·68	29·67	29·59
June	8	1	4	13	1·41	·14	·71	2·26	29·82	29·70	29·61	29·75
July	6	4	5	15	·65	1·39	·99	3·03	29·62	29·77	29·83	29·73
August ..	5	2	4	11	·93	·12	·46	1·51	29·68	29·73	29·63	29·67
Summer	19	7	13	39	2·99	1·65	2·16	6·80	29·72	29·75	29·70	29·72
September	5	2	1	8	1·65	·21	·46	2·32	29·59	29·50	30·15	29·64
October ..	10	2	4	16	2·75	·40	1·26	4·41	29·57	29·40	29·66	29·57
November	8	4	2	14	1·78	·29	·31	2·38	29·64	29·66	29·42	29·62
Autumn	23	8	7	38	6·18	·90	2·03	9·11	29·60	29·56	29·66	29·60
Year	73	37	26	136	16·20	4·66	5·31	26·17	29·63	29·69	29·69	29·65

DISCUSSION.

Mr. SCOTT regretted that Mr. Wallis had not given any account of previous work on the same subject. Mr. Blanford had written a paper on the sudden changes of the barometer (rises), accompanied with rain, in India. Dr. Hann had also discussed the rainfall in connection with barometer changes at Batavia, and had found that heavy rains caused the barometer to rise. It was a pity the period discussed by Mr. Wallis was so short.

Dr. TRIPE thought that if persons never took up small investigations a good deal of useful information would never be obtained. The results of Mr. Wallis's paper were somewhat different from what he had expected.

Mr. C. HARDING said that the chief point of the paper seemed to be that rain occurred mostly with a falling barometer. He thought in this way that the results obtained fully confirmed what had been shown by Mr. Abercromby and others, that with a cyclonic disturbance the rain area was very greatly confined to the front of the barometric depression. He had taken out the rainfall for London during October, 1882, as given in the *Daily Weather Reports*, and found that out of 21 entries of ·02 inch and above, 18 occurred in the front of an approaching area of low pressure ; but the month tested probably had a greater number of depressions than usual, and had another month been taken a somewhat different result might have been obtained.

Mr. SYMONS remarked that the paper seemed to be an exponent of the rain which falls in various parts of a cyclone area, and a numerical illustration of the cyclone weather maps by Abercromby and others.

The PRESIDENT (Mr. LAUGHTON) said that the paper did not deal with the rise or fall of the barometer, as affected by rain, but rather with the position of an advancing or receding centre of depression relatively to the place of observation. In this way, by a different method of investigation, it appeared to corroborate the results which Mr. Abercromby had lately brought before the Society. The effect of rainfall on the rise or fall of the barometer was a totally different question, which Mr. Wallis had eliminated from the consideration before him. It was commonly said by physicists that the condensation of vapour into rain must necessarily lessen the pressure of the air and cause a fall of the barometer. This was only one more case in which theoretical and even experimental physics were set at defiance by the observations of natural phenomena ; for, as a matter of fact, a rise of the barometer had, as Mr. Scott had just mentioned, been frequently observed as accompanying heavy rain in the tropics.

Mr. WALLIS, in reply, said that he did not attach scientific value to the paper, but thought it would be interesting to many of the Fellows. He also thought that it tended to show that the barometer was a better weather guide than was sometimes supposed to be the case.

METEOROLOGICAL OBSERVATIONS AT ZANZIBAR. Taken by Surgeon-Major C. T. PETERS, M.B., Bombay Army, Acting Civil Surgeon at Zanzibar, during 1880-81.

[Read May 16th, 1883.]

IN December, 1879, when starting for Zanzibar, I was permitted by the Bombay Government, on the recommendation of Mr. F. Chambers, the Meteorological Reporter for Western India, to take with me a set of meteorological instruments; and this arrangement was sanctioned by the Government of India.

On arrival in Zanzibar my first efforts were directed towards the selection of suitable spots for placing the instruments, in which I received the cordial and able help of Her Majesty's Agent and Consul-General, Sir John Kirk,

K.C.M.G. A place was erected over the roof of the Civil Surgeon's quarters for the anemometer, while the other instruments were placed in suitable rooms already in existence.

The following description will give an idea of the position of the instruments:—

The barometer was placed in the coolest room of the house, facing the North, and having the harbour in that direction in front, the sea beach lying within a hundred feet from the house. The cistern of the barometer is 17 ft. 7 ins. above the highest tide mark. The difference between the highest and lowest tide levels is estimated at 10 ft.; so the height of the cistern of the barometer is 22 ft. 7 ins. above the mean tide level.

The thermometer screen was placed in an open room built on the top of the house, having a wooden roof tiled with Indian red-brick tiles, supported on pillars, and therefore perfectly open in the East, North, and West; but to the South the wall has been built up to the roof, with the exception of a doorway and four openings as ventilators, with a view to keep out the rain and the glare from the heated roof. The spaces between the pillars to the West were filled in with wooden Venetian windows to keep out the rays of the sun; so that the temperature fairly approximates to the temperature of the air in the shade. This room is 45 ft. in length from East to West, and 22 ft. broad from North to South. The height of the ridge of the roof above the floor is about 11 ft., and of the pillars supporting the roof about 7½ ft. The screen is 4 ft. from the floor of the room, and 84 ft. above the ground.

The rain gauge is at the South-western angle of the roof of the house, the surface of the mouth of the funnel being 33½ ft. above the ground and 46 ft. above the mean sea level.[1]

The anemometer is placed over the highest part of the roof of the house on a thick teak-wood board, supported on two stout masonry pillars 8 ft. above the ridge of the tiled roof. There are no high objects near which are likely to cause any eddies. The cups are 48½ ft. above the ground, or 61 ft. above mean sea level.

The solar and grass thermometers are exposed in an enclosure on the Northern side of the Vice-Consulate; the grass thermometer is supported on a woollen pad, which lies over the grass; while the sun thermometer is mounted on a stand 4 ft. high from the ground.

Zanzibar is taken as in S. lat. 6° 9′ 43″, E. long. 39° 11′ 11″. This gives the corrected latitude and longitude of the present British Consulate General at Shangani Point, which affords a much better landmark than the low Fort, about 400 yds. eastward of the Consulate in the middle of the town, which cannot be easily distinguished from a distance. Formerly Zanzibar was estimated from the Fort to be 6° 9′ 40″ S. lat. and 39° 14′ 20″ E. long. The position given above is adopted by the Admiralty in the third edition of the *Africa Pilot*, Part iii., published in 1878. The Magnetic Variation, according to the same authority, as estimated in 1870, is 10° 15′ W., and the wind observations have been corrected accordingly.

[1] Dr. Robb calculates it at 44 ft.

The observations were taken at hours fixed for the observations in India, namely, 10 hrs., 16 hrs., and 18 hrs.; while the radiation grass thermometer was always read before 8 hrs. and taken in for fear of breakage by exposure to the bright rays of a morning sun. There was also a synoptic observation on the plan of the late General Myer, of the United States Signal Service, at Greenwich mean time 12 h. 48 m., which corresponds with the Zanzibar mean time 15 h. 20 m. This time has been altered to 14 h. 45 m. since the beginning of 1881.

As the local time is reckoned in Zanzibar from sunset to sunset, according to the Arabian practice, and the hour of sunset is for ordinary purposes considered to correspond with 6 p.m., the clock in the Sultan's Tower, which indicates the sunset time, gave a variation of about 22 minutes during some times of the year, so it was necessary to calculate the mean time. This was effected in the following ways:—1. By the mean Greenwich time kindly furnished by the officers of H.M.S. *London* and other Royal Naval steamers lying in harbour; 2. By telegraphic communication from Aden, whence the correct mean Madras time was obtained; 3. By means of a table furnished by the Meteorological Office, Bombay, to reduce the sunset time as indicated by the Sultan's clock into the mean Zanzibar time. This explanation is necessary, as the previous observations before my arrival were recorded according to the sunset time.

On my arrival in Zanzibar I found that a series of observations had been taken by Dr. Robb, F.R.Met.Soc., with instruments issued by the Meteorological Office in London for the use of Lieut. Cameron's expedition, and others of his own.

On Dr. Robb's departure for Europe, some of the observations were kept up, except for a few weeks at the commencement of the year 1879, by the late Dr. B. L. Dutt.

On my arrival, therefore, I tried to retain the position of the instruments as far as practicable, but I found that with the exception of the rain gauge the position of the other instruments could be improved upon. Consequently, after consulting with Sir John Kirk, I removed the barometer, which was placed not only in dangerous proximity to the doorway, but also to the rays of the sun from a western window, and placed it in a cooler part of the house, having a side light. In effecting this change, the cistern of the barometer was lowered 1½ ft. below the position it formerly occupied; whilst by having the Cameron marine and the mountain barometers side by side, I was enabled to take readings from both, so as to be able to compare the readings of the two, and thus connect Dr. Robb's observations with those taken by the new set of instruments brought from Bombay. In this way, so far as the barometric readings were concerned, the results were highly satisfactory, as were also the readings of the rain gauge. I also kept a double set of observations with the dry and wet bulb and maximum and minimum thermometers. These readings were not, however, comparable. The dry and wet bulb thermometers were placed on the wall in an Eastern verandah of the house, under a corrugated zinc roof, and the readings in this position gave

higher results in the forenoon than those of the instruments placed in the new position, namely, in the centre of a large room having an open exposure; and the maximum reading for the day was often reached at 10 hrs., while the afternoon readings were much lower, in consequence of the shadow of the house falling over the verandah.

The maximum and minimum thermometers, which were placed on the wall inside the passage, were similarly affected by either draughts of cold air from the outside by day or the heated air by night; and consequently the maximum thermometer gave much lower, and the minimum thermometer much higher, results than the thermometers placed in the new position.

With regard to the Zanzibar observatory, Mr. F. Chambers, in his Report for 1879 to the Government of Bombay, states, "A very important new observatory, furnished with good verified instruments from Bombay, has been established by Dr. C. T. Peters at Zanzibar, on the East coast of Africa. Recent investigations having shown that the peculiar characteristics of the monsoons of different years are intimately related with general meteorological indications of the Indian Ocean, it becomes of great importance that early and reliable information of these conditions should be obtained. As Zanzibar is now in telegraphic communication with Bombay . . . . it has now become possible to obtain such information."

The accompanying tables give the results of 14 months' observations, from the 1st of February 1880 to the 31st of March 1881, and with regard to them Mr. Chambers remarks, in his Administration Report for 1880-81, as follows:—"It now seems quite possible to make use of meteorological observations not merely for storm warning purposes, but also for the more important object of forecasting in a general way the character of a coming monsoon season. In my last Report I pointed out that there is on the average in the Bombay Presidency a definite relation between the height of the barometer and the quantity of rainfall, the latter being above the average when the former is below it, and *vice versâ*. . . . There is good reason, therefore, for believing that if these waves of high or low pressure could by any means be anticipated, the corresponding character of the accompanying rainfall might be foreseen. Now I have recently found that the abnormal barometric movements of long period are similar in character at widely separated stations, but with this important difference, the movements occur at the more Westerly stations much earlier than at the more Easterly ones; for instance, between Bombay and Calcutta there is an average difference in time of more than two and a half months, Bombay being first affected. It follows, therefore, that the observed barometric movements at Westerly stations might be utilised to forecast the general character of the impending changes at the more Easterly ones, much in the same manner as the knowledge of the existence of a cyclonic disturbance at one part of the earth's surface can be utilised for forecasting the character of impending changes at those places towards which the vortex is advancing. From this point of view the observations recorded at Zanzibar during the past year by Dr. C. T. Peters become especially interesting. Comparing them with the observa-

tions of previous years, recorded by Dr. Robb, and with those recorded in Western India, it would appear that a wave of moderately high pressure has been slowly passing over the Arabian Sea between April 1880 and June of the present year (1881). The highest point of the wave appears to have passed over Zanzibar in October 1880, since which time the abnormal pressure has on the whole been falling, at least up to May last, when the pressure was slightly below the average. At Bombay, however, the pressure did not rise above the average till June 1880, two months later than at Zanzibar, and the highest point of the wave was not reached till January of the present year, about three months later than at Zanzibar. The general course of the Bombay curve has since been downwards, following the Zanzibar curve at an interval of two or three months. As far, therefore, as a judgment can be formed from these results, it would seem probable that the pressure at Bombay will fall to, or below, this average in July or August next, and if so, at least an average rainfall during one if not both of those months may be anticipated."

This was written at a time when some anxiety was felt by the scanty rainfall during the early months of the monsoon season in 1881, and Mr. Chambers's prediction was fully realised by the rainfall in the Bombay Presidency in July and August, and later on in the year in Bengal.

Since Mr. Chambers's return to Europe on furlough, Mr. A. N. Pearson, who is acting for him as meteorological reporter for Western India, has continued these investigations, and he is also of opinion that by studying the barometric readings at Zanzibar the general nature of the seasons in Western India may be anticipated some months beforehand. After referring to the atmospheric wave which passed over Zanzibar in October 1880, and which was felt in Bombay three months later, he speaks of a minimum abnormal variation which occurred in Zanzibar in November 1881, and was expected to arrive in Bombay in April 1882, which it did with the greatest punctuality; and he further expected that the abnormal variations of the barometer at Bombay and Belgaum and throughout the Presidency between July and December 1882 would follow the same course of variations as occurred in Zanzibar during the months of March, April, May, June and July, which was an upward movement.

At the same time, Mr. Pearson thinks that there are movements at Zanzibar which do not reappear in the Eastern stations, while again there are movements in Bombay which have not been previously experienced at Zanzibar; and Mr. Pearson believes that there is "some influence which tends to produce irregularities in the Eastward transmission of these abnormal movements, and this influence must be discovered, and its occurrence foreseen and allowed for, before the Zanzibar curves can be used for the purpose of predicting the nature of the seasons in Western India."

There is no doubt that the cause of these irregularities could be better understood if meteorological observations were established at the Seychelles and the island of Socotra.

The highest mean of barometric pressure at 10 and 16 hrs. was 30·112

ins. in July, the lowest 29·860 ins. in February 1880—and the mean for the 14 months was 29·954 ins. The cistern of the barometer was 22·6 ft. above mean sea level.

Wind.—The anemometer readings demonstrate clearly the existence of land and sea breezes, as will be seen by the prevalence of the Easterly element in the afternoons throughout the year, while the Westerly element prevails in the forenoons. Situated as the island of Zanzibar is on the East coast of the great African continent, and having no land to the Eastward nearer than Australia, the sea breeze here is from an Easterly direction.

The prevailing winds are from the SE, giving 115 observations during the 14 months—SW 113, SSW 93, S 62, WSW 61, N 60, ESE 54, NNW 58, SSE 45, ENE 41, NE 33, NW 22, E and NNE each 17, W 15, WNW 6, and calm 10.

From April to September the prevailing winds have a Southerly element, veering from SW to SE. This is the Monsoon season—the velocity of the wind rises steadily from April to June, when it reaches its maximum, after which it lessens steadily until October. From this time until December it retains its minimum velocity, during which time the Northerly element begins to increase, while the Southerly element is still perceptible during the forenoon, thus facilitating the trade between Zanzibar and the countries lying both to the North and South of it. After December, and until March, the Northerly element continues to prevail. This is the season commonly known as the North-east Monsoon, when sailing vessels from Arabia and India come into Zanzibar, whilst vessels returning to those ports have to do so before May, or else they are detained until September, when again the native crafts begin to venture out to sea.

The mean hourly velocity of wind, regardless of direction, was as follows :—

	Miles.		Miles.		Miles.
February, 1880	7·18	July, 1880	9·92	December, 1880	5·06
March, ,,	6·44	August, ,,	6·97	January, 1881	11·54
April, ,,	8·15	September, ,,	6·77	February, ,,	6·18
May, ,,	11·00	October, ,,	6·10	March, ,,	7·09
June, ,,	11·10	November, ,,	5·88		

Rainfall.—The total rainfall during the year 1880 was 47·17 ins., including that of January (1·70 in.), which is not shown in the table; and this year may be said to be one of scanty rainfall, Dr. Robb's average for 5 years being 61·01 ins. There appears, however, to have been a steady diminution in the rainfall of Zanzibar since the island has been cleared of its forest trees by the advancement of cultivation, chiefly in clove plantations.

The period of heaviest rainfall was during the months of March and April, at the commencement of the South-west Monsoon, and again in November and December, at the close of the Monsoon season. These two periods comprise the double rainy season of Zanzibar.

Temperature.—Zanzibar being situated 6° South of the Equator, the highest readings in the shade are obtained in February and March: for instance, the maximum temperature on the 12th of February 1880 was 90°·8, and on the

RESULTS OF METEOROLOGICAL OBSERVATIONS TAKEN AT ZANZIBAR DURING THE YEAR 1880-1881.

Months.	Atmospheric Pressure.			Temperature of the Air.									Radiation.						Vapour Tension.		Relative Humidity.		Mean Amount of Cloud at 10 and 16 hours.	Rainfall.	
													Solar.			Nocturnal.									
	10 hours.	16 hours.	Mean.	Highest.	Date.	Lowest.	Date.	Mean Maximum.	Mean Minimum.	Mean at 10 hours.	Mean at 16 hours.	Mean of 10 hours, 16 hours, and Minimum.	Mean Maximum.	Highest.	Date.	Mean Minimum.	Lowest.	Date.	10 hours.	16 hours.	10 hours.	16 hours.		Total.	No. of Rainy Days.
1880.	In.	In.	In.	°		°		°	°	°	°	°	°	°		°	°		In.	In.	o/o	o/o		In.	
February	29·942	29·826	29·884	90·8	12	75·4	16	86·7	78·4	81·9	86·4	82·2	152·5	162·9	13	71·9	67·8	1	·874	·857	80	68	5·78	2·18	11
March ..	·957	·839	·898	89·3	25	75·2	17	86·3	78·4	81·9	85·6	82·0	157·2	165·7	19	71·1	66·4	10	·867	·855	80	70	5·07	8·48	15
April	29·983	·870	29·926	88·1	10 & 12	72·9	30	84·8	77·1	80·4	83·6	80·4	155·1	163·7	1 & 5	72·3	69·9	1	·890	·862	83	75	8·16	13·10	21
May	30·060	29·962	30·011	85·7	5	71·1	15	82·4	74·7	78·0	80·3	77·7	146·2	162·5	27	70·0	66·2	19	·784	·759	82	74	7·66	5·45	14
June	·130	30·034	·082	84·3	19	71·6	24	82·7	74·5	77·5	81·4	77·8	154·8	161·0	23	66·5	64·0	29	·710	·643	75	60	5·20	0·19	3
July	·181	·093	·136	82·3	8 & 15	69·7	11	80·3	72·4	75·1	78·8	75·5	150·4	162·7	30	63·9	60·1	30	·706	·657	81	67	7·21	2·24	11
August ..	·149	·046	·099	84·1	30	69·9	20	81·0	71·7	75·0	79·9	75·5	150·7	164·0	18	61·1	58·3	14	·706	·630	81	63	6·07	1·84	12
September	·143	·027	·085	86·0	23	72·2	7	83·2	73·2	76·7	81·2	77·0	154·8	163·5	24	61·2	58·5	3	·713	·646	78	61	5·58	0·02	1
October ..	·099	30·020	30·060	86·1	29 & 30	72·4	6 & 8	82·5	74·0	78·4	81·6	78·0	149·9	160·7	9	63·6	60·5	8	·755	·706	77	66	7·06	3·79	14
November	30·034	29·916	29·975	88·1	20	73·4	8	83·7	75·7	79·7	82·3	79·2	154·1	164·2	13	66·4	62·9	3	·826	·793	81	72	7·20	3·84	12
December	29·999	·882	·940	87·1	20	75·5	24	85·3	77·5	80·7	84·2	80·7	154·8	161·1	6	68·6	65·0	9	·848	·819	82	70	5·47	4·34	13
1881.																									
January	·972	·856	·914	87·2	13	72·0	18	84·3	76·7	79·6	83·5	80·0	150·8	163·6	5	71·1	65·8	27	·821	·784	81	68	6·79	2·74	7
February	·964	·861	·912	86·7	3	74·1	27	83·9	77·0	80·4	82·2	79·9	150·4	161·7	22	69·9	65·5	1	·852	·850	82	78	8·20	15·14	19
March ..	29·960	29·831	29·896	90·6	28	74·4	1	87·3	79·2	82·3	85·8	82·4	153·3	160·0	29	72·0	68·6	10	·899	·871	81	71	7·37	2·39	6

RESULTS OF METEOROLOGICAL OBSERVATIONS TAKEN AT ZANZIBAR DURING THE YEAR 1880-1881.—*Continued.*

Months.	Number of Observations of the Direction of Wind at 10 and 16 hours.																	Prevalence* and Direction of Prevailing Winds.	Hourly Velocity of prevailing Wind, regardless of Direction.	Mechanical Components of Wind in miles per hour.			
	N.	NNE.	NE.	ENE.	E.	ESE.	SE.	SSE.	S.	SSW.	SW.	WSW.	W.	WNW.	NW.	NNW.	Calm.			Mean at 10 hours.		Mean at 16 hours.	
																				N.	E.	N.	E.
1880.																			Miles.	Miles.	Miles.	Miles.	Miles.
February	14	7	4	5	4	1	2	3	1	3	4	1	2	0	2	1	2	33 N 29° E	7·18	+ 6·47	—1·07	+ 1·36	+5·53
March ..	6	6	2	1	1	4	5	4	7	13	4	1	1	0	1	3	0	24 S 11° E	6·44	— 2·01	—2·90	— 1·10	+3·53
April	0	0	1	0	0	2	12	6	11	8	14	3	0	0	0	0	1	75 S 3° W	8·15	— 7·35	—4·27	— 6·15	+3·30
May ...	1	0	0	0	0	0	15	6	11	12	7	4	0	0	0	0	0	42 S 1° W	11·00	—10·73	—4·19	— 3·93	+3·55
June	0	0	0	0	0	2	16	6	11	14	9	1	0	0	0	0	0	82 S 3° E	11·10	—11·89	—5·67	—11·37	+7·77
July	0	0	0	0	1	9	18	3	11	11	5	3	0	0	0	0	0	76 S 16° E	9·92	— 9·39	—3·63	— 8·39	+9·98
August ..	2	0	0	1	1	17	4	4	1	9	14	5	0	0	0	0	1	54 S 7° E	6·97	— 6·81	—5·51	— 5·16	+8·84
September	4	1	0	1	2	6	9	3	0	8	8	12	1	0	2	2	0	37 S 18° W	6·77	— 5·94	—6·21	— 2·85	+6·16
October ..	0	0	0	4	3	6	13	4	5	5	14	2	1	0	0	3	0	53 S 13° E	6·10	— 7·60	—3·39	— 4·95	+6·32
November	3	0	4	4	4	4	3	1	1	5	6	10	3	0	7	5	0	14 S 81° W	5·33	— 1·57	—5·23	+ 0·14	+4·06
December	4	0	7	9	0	0	3	1	0	1	10	5	0	2	6	12	1	28 N 25° W	5·06	+ 4·55	—5·20	+ 2·62	+5·21
1881.																							
January	20	2	9	7	0	0	1	0	0	0	3	1	0	2	1	13	1	69 N 5° E	11·54	+17·61	—2·58	+ 6·26	+5·70
February	3	0	3	1	0	1	8	2	1	2	11	2	5	0	1	6	4	22 S 47° W	6·13	— 0·41	—4·46	— 2·00	+2·11
March ..	3	1	3	8	3	2	6	2	2	2	4	11	2	2	2	8	0	4 N 68° W	7·09	+ 1·80	—5·38	— 0·05	+5·72

* The prevalence and direction of the wind are calculated by Lambert's formula, the prevalence being indicated as a percentage of the total number of observations.

28th of March 1881, 90°·6, while the lowest readings occur in July and August, 69°·7 on the 11th of July 1880, and 69°·9 on the 20th of August 1880. March is decidedly the hottest month in the year. About the middle of April the weather begins to be perceptibly cooler, and in August the air attains its minimum temperature. In December the temperature again begins to rise, and attains its maximum in March.

The annual range of temperature is 21°·1; the greatest monthly absolute range was 15°·4, in February 1880, and 16°·2 in March 1881, and the minimum range in December 1880 was 11°·6.

The mean temperature of the air during the 14 months was 79°·1 at 10 hrs., 82°·6 at 16 hrs., and the mean of the minimum temperatures at 10 hrs. and 16 hrs. was 79°·2.

The mean relative humidity was 79·7 per cent. at 10 hrs. and 68·8 per cent. at 16 hrs.

The vapour tension showed a gradual rise from September to December, a slight fall in January, after which the rise continued through the months of February, March, and April, when it attained a maximum of ·890 in. at 10 hrs., and ·862 in. at 16 hrs. This was followed by a rapid fall in May, which continued until August, when the lowest tension was obtained, ·706 in. at 10 hrs., and ·680 in. at 16 hrs.

The solar radiation thermometer is so much affected by a cloudy sky, that no deductions can be made from its readings. The highest indication was obtained in March (about Midsummer) 165°·7, and even in August, about Midwinter, it registered 164°. The mean readings gave 157°·2 in March, and 146°·2 in May.

The grass thermometer gave the lowest readings in August, 58°·3, and September, 58°·5.

The maximum difference between the mean solar maximum and the mean maximum in the shade was 72°·2 in June, and the maximum difference between the mean nocturnal minimum and the mean minimum in shade was 12°·0 in September, when the rainfall was almost *nil*.

DISCUSSION.

Captain MACLEAR remarked that if it were the case that the seasons in India could be foretold by the mean barometric height at Zanzibar some months previously, in all probability better indications would be obtained at the Seychelles Islands away from the influences of the African Continent. In any case a station at the Seychelles would be very valuable, and could be best effected by supplying instruments and training the keeper at the lighthouse on the Northern Island.

Mr. STRACHAN thought that a station on an island in the Indian Ocean would be of great use. He also remarked, respecting the times of rainfall at Bangkok p. 241), that Mr. Sawyer had found much the same result when discussing the rainfall at Brighton.

The PRESIDENT (Mr. LAUGHTON) thought it impossible to overrate the importance of Mr. Chambers's suggestion that the observations at Zanzibar might be found to indicate the weather of Bombay several months later. He hoped this point might be examined more closely, with a view to confirming or disproving it. Observations at the Seychelles would be a necessary supplement to those at Zanzibar, and there ought not to be any difficulty in getting them; but he understood that conflicting departmental interests might possibly stand in the way. Zanzibar, under the Bombay Government, belonged to the India Office; the Seychelles to the Colonial.

New Method of reading a Thermometer and Hygrometer at a distance by means of Electricity. By Arthur Wm. Waters, F.G.S., F.L.S. (Abstract.)

[Read May 16th, 1883.]

In cold districts such as the mountainous regions of Switzerland it is very difficult to find persons willing to go any distance through the snow, early and late, to take meteorological observations, and in consequence meteorologists among the Alps place the instruments in metal boxes just outside their windows. As an invalid, and unable to expose myself to the weather at any hour, I set to work to see if a thermometer could be arranged to be read electrically at a distance.

Having had my thermometer working satisfactorily for about three months, and having just completed a hygrometer, I feel justified in describing them as practically useful.

Hermann's spiral metal thermometer, which consists of a spiral of two metals welded together, is employed. The centre of the spiral is fixed, and the other end moves a hand. The instrument serves as a maximum and minimum, having two light indices, which are moved to the right or left as the temperature rises or falls, and then are left, one at the highest and the other at the lowest point.

I have also adapted my principle to the hair hygrometer, which moves a hand in the same way as the thermometer.

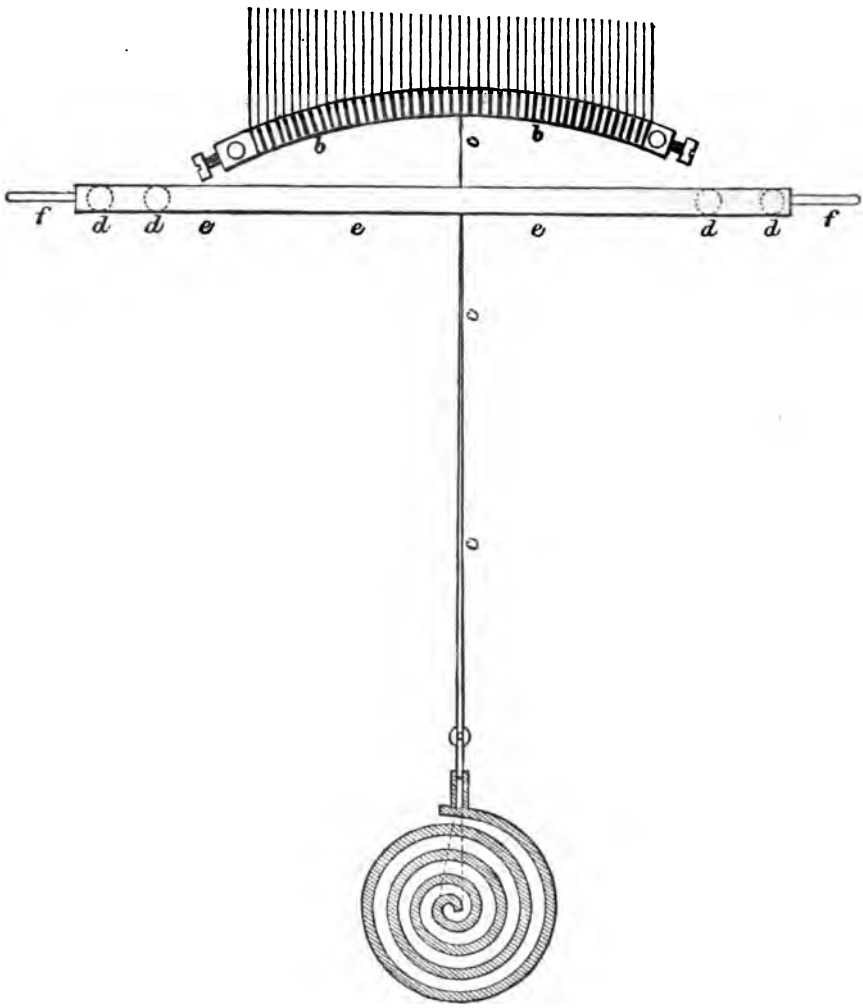
In order to determine the position of these hands it was necessary to make a satisfactory electrical connection without influencing their indications, as a slight force would either retard their action or move them out of their position.

Eventually the plan was adopted of making the scale with raised wires in connection with a galvanometer in my room. The scales were constructed of pieces of ebonite mounted on hard wood. In the scale *b b* (Fig. 1) grooves were cut in which the wires were laid. The silk covering was removed from a small portion of a length of German silver wire 0·8 millimetre in diameter, and this uncovered part was placed in the grooves, being tightened by drawing its end through holes bored in the hard wood which supported the ebonite. The spaces between the wires were then filled up with shellac, so that a firm and solid scale was made, with alternate metallic and insulating spaces.

The whole scale is supported on two brass pillars passing through it at each end, and thus can be raised or lowered, and held in position by the screws shown.

The scale was placed about 1 millimetre below the index, with an electromagnet, *d*, *d*, on each side, and above these there is a long armature, *e e*, which is attached by watch springs *f f* to two pillars, being less than a millimetre above the index, until a current is sent through the electromagnet, *d*. When the armature is attracted it pulls down the index on to one

FIG. 1.

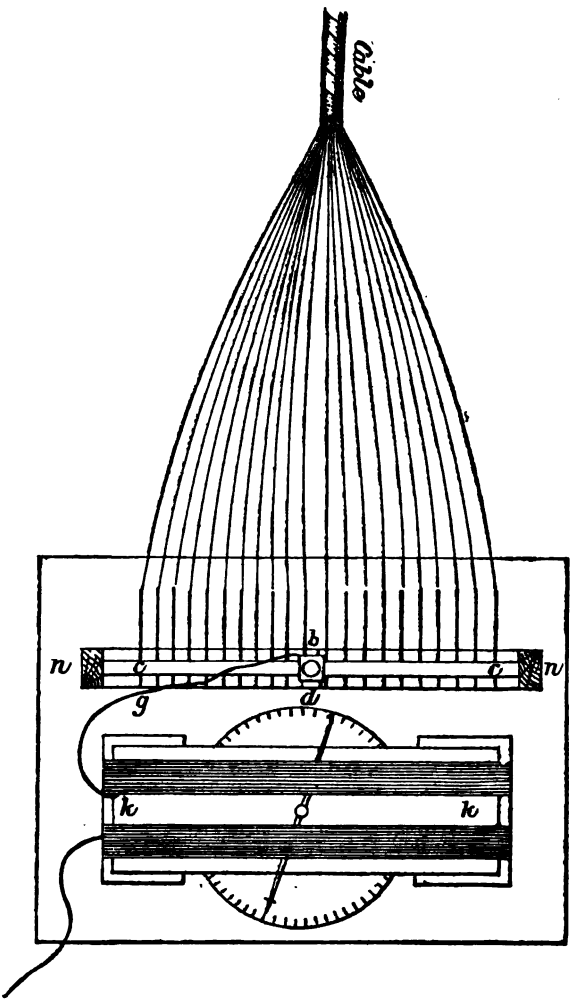


of the wires, where it is held tightly, thus making a good electrical connection.

The instrument is being worked with a cable containing twenty-five fine wires, and the thermometer scale is divided to thirds of a degree centigrade.[1] The cable is 85 metres long, and consists of twenty-five wires 0·2

[1] Since the above Paper was written, the author has completed another instrument, in which the divisions were to 0·°1 C. and as the weak point of the system is the slow action of the thermometer, he had a more sensitive thermometer made by Hermann and Pfister, of Berne. This consisted of two spirals a short distance apart, and connected up to work the same index. The spirals were made of steel and brass, instead of iron

Fig. 2.



millimetre in diameter, and five wires 0·4 millimetre in diameter, in both cases double cotton covered. One leading wire is electrically connected with the index of the thermometer, and another with that of the hygrometer.

and brass, and could thus be smaller, and more sensitive. The divisions being to 0°·1 C. the scale was longer, and so it was found advisable to adopt an armature with a double curve instead of the straight one.

As a series in this case only represented 2°·1 C. he attached small blocks of insulated German silver to the under side of the armature, which, when drawn down, made contact with the index, and by means of thin wire leading from each block was able to tell when contact was made in the same way as with the scale. This is probably better than the plan first used, where each wire of a series had a certain measured resistance inserted.

This is not fastened to the index, as the free action might thus be interfered with, but to its bearing. In this way the electrical current passes along the index, and as soon as the circuit is closed by the index being brought into contact with one of the wires of the scale it is shown upon a small galvanometer in the room.

The apparatus for reading the temperature indicated is as follows (Fig. 2, p. 207):—

Twenty-one stout wires are laid upon a square piece of wood, and attached severally to the ends of the wires of the cable. A brass spring, running loosely on a brass bar, *c*, is placed above the stout wires, and then one of the wires, *g*, of the galvanometer is fastened to the upper end of this spring by means of a binding screw, *b*.

It will be seen that if the index of the thermometer is touching one of the wires of the scale it is only necessary to bring the spring over the corresponding wire to close the circuit, which will be indicated upon the galvanometer. This is done by sliding the spring along the bar *c*; and when the right wire is reached, the galvanometer needle is deflected. Any simple compass or astatic galvanometer is sufficient for taking the readings.

The galvanometer, *k k* (Fig. 2), is attached to the same small board as the "reader," *n n*, and in this way, by having a sufficiency of spare cable, the board with reader and galvanometer can be carried about and by using a battery, as Leclanché's or Daniell's, can be even used in bed, the board being placed on a table by the bed ready for the early morning observation.

A small battery only is required, as two moderate-sized Leclanché cells will work the magnets, and one small Leclanché cell is sufficient for the thermometer index and galvanometer in circuit.

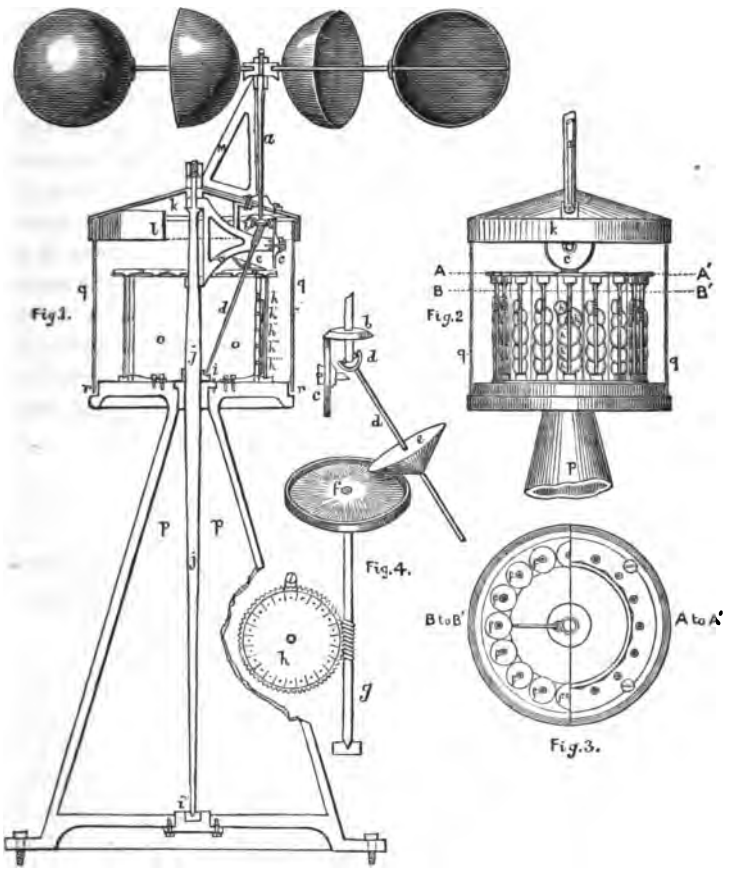
An Integrating Anemometer. By William F. Stanley, F.R.Met.Soc.

[Read May 16th, 1883.]

In our President's exhaustive historical sketch of anemometry and anemometers, read March 15th, 1882, he gives a brief description of several forms of integrating anemometers by which the total amount of aerial displacement in any direction during any interval may be measured.[1] The methods described, devised by Lomonsow, Beaudoux, Goddard, and Craveri, were severally by dropping mercury, sand, water, and grains of corn from vessels or apparatus into separate vessels over which the dropping apparatus was directed by the wind. The amount of dropped matter in each vessel was afterwards weighed or measured, and taken to be a register of the quantity of wind blowing in one direction for a certain time. As it appeared that such integration of direction could be readily accomplished much more correctly by strictly mechanical means, I shortly afterwards made a drawing

[1] *Quarterly Journal.* Vol. viii. pp. 173-4.

showing how it might be done. I also made a model to demonstrate the principle. (This was placed before the meeting). The description of the parts of the drawing is as follows:—Fig. 1 is a vertical section; Fig. 2, elevation of the recording part of the instrument; Fig. 3, horizontal section of the same parts. The letter *a* represents the vertical axis of a Robinson's anemo-



Figs. 1. Vertical Section.—2. Elevation.—3. Transverse Section.—4. Details: *a*, Shaft of Robinson's Anemometer; *b*, Flange to Antifriction Wheel, *c*, supporting weight of Anemometer; *d*, Conoid Shaft with Hook's Joint; *e*, Conoid; *f*, Crown Wheel; *g*, Spindle of Worm Wheel; *h h' h''*, Calculating Wheels; *i*, Agate bearing to Conoid Shaft; *i''* bearing to principal Shaft, *j*; *k*, Metal Cover revolving with Shaft, &c.: *l*, Counterpoise Weight; *m*, Bracket supporting *a*; *n*, Bracket supporting Antifriction Wheel; *o*, Cylinder to which calculators are fixed; *p*, Cast-iron Base; *q*, Glass Cylinder over works resting loosely upon rabbet *r*.

meter, which is placed in a position horizontally eccentric to the principal axis of the instrument shown at *j*, so that the wind can carry the axis *a* through pressure upon the Robinson's cups, which it supports, in any direction outward from the principal axis opposite to the direction of the wind blowing at the time. The axis *a* is connected at its lower part with a flange *b* and a Hook's joint *d*. The flange is supported by an antifriction wheel *c*, which

supports the axis and permits it to move freely. The Hook's joint communicates with a rod *d* centred obliquely to the principal axis *j*. This rod *d* carries a conoid *e* which moves upon the surface of a crown-wheel *f*, and thus communicates with the recorder for one direction. The recorder is shown *h*, *h'*, *h''*. The conoid *e* is made of such form and placed in such position that the length of the line of its rolling contact upon the crown-wheel shall vary inversely at every point of horizontal displacement as the sine of the angle to the axis of the conoid (taken horizontally) to the periphery of the crown-wheel. By this means the same amount of motion is communicated to the crown-wheel from the axis *a*, whether it is just on the edge of the crown-wheel or radial to its centre. Contact of the conoid and crown-wheel is secured by a spring under the axis of the crown-wheel. By arranging a number of crown-wheels with recording apparatus in a circle so as to give to each a position about one point of the compass, the amount of aerial displacement in any direction may be registered according to the motion of the Robinson's cups. I may notice that there is a small error by reason of the conoid not being active quite at the point of first contact with the crown-wheel, where the sine should be taken for an infinitely small angle, but by a small compensation in the form of the conoid, and a slight displacement from its true position, this error may be nearly eliminated.

On the Structure of "Cirro-Filum," or the Ice-cloud disposed in Threads. By the Rev. W. Clement Ley, M.A., F.R.Met.Soc.

[Read June 20th, 1883.]

Of the cirriform clouds one of the most important to the weather forecaster is that to which I have given the name Cirro-filum. Having from the time I was twelve years of age, and even earlier, carefully observed this cloud whenever visible, and having for the last twenty-five years made it the subject of minute study, I am enabled to lay before this Society some results which will, as I hope, prove of value. I shall first give a short account of the mode in which I was led to prosecute this study; secondly, a classification of the more recent and reliable observations; and lastly, an explanation of the principal phenomena observed. It had been my intention to add further, a description and explanation of the cross-ribs frequently observed in Cirro-filum, and to conclude the paper with practical rules for the forecasting of weather from observations of Cirro-filum. Pressure of work has rendered it necessary that I should defer this to a future communication.

During the earlier part of my series of observations I obtained results which were of little utility, in themselves, because I relied on a classification of clouds according to which there are, on the one hand, no recognised distinctions between objects which are very dissimilar in form and structure, and on the other, alliances are insisted upon which are of an artificial kind. The results thus obtained were a few general laws of the simplest character, and

a vast number of associations wanting in definition, and therefore incapable of assortment. The general laws were these:—

I. Facing the wind at the earth's surface, in a large majority of cases the upper currents move somewhat from the right hand to the left. The majority consist principally of instances in which the wind has recently veered more than two, but less than fourteen points.

II. Currents from the West predominate over those from the East in the higher regions of the atmosphere to a far larger extent than is the case at the earth's surface.

III. The higher strata of the atmosphere move, as a rule, with much greater velocity than the lower.

The associations above alluded to may best be described as belonging to that class, the possession of which constitutes what I believe is called weather wisdom:—the likelihood of strong winds after abundant cirrus, the probability of a change of wind after a parhelion, the estimation of the chances of rain within a given number of hours after a "Noah's Ark." The mention of the nature of these matters, pertaining somewhat to the infancy of cloud-study, will suffice, this Society having to some extent dealt with them.

Up to the spring of 1872 (when the daily weather maps began to be issued by the Meteorological Office), I constructed daily charts of isobars, winds, and areas of rain from the weather reports printed in the newspapers, and while engaged in this work soon came to perceive that certain relations, of an obscure, and as it first seemed of an exceedingly variable nature, existed between those elements shown in the charts, and the cloud-forms described in a diary. One of the phenomena which first claimed attention was the existence of a sheet of ice-cloud extending in front of those areas of rainfall which themselves commonly occupy the front portion of an advancing barometric depression. As the shape of the sheet of ice-cloud commonly coincided somewhat closely with that of the *nimbus*, or area of rainfall which succeeded it, it was plain that a causal relation of some sort existed between the two phenomena. Prior to the advance of the sheet of ice-cloud above mentioned, I commonly noticed long threads of extremely elevated cloud, which proved to be parallel, or nearly so, to the exterior margin or selvedge of the sheet itself: it therefore appeared to me to be possible by ascertaining the longitudinal direction, or as I shall in the remainder of this Paper term it, the "filature" of these threads, to obtain useful premonitions of the advance of barometric depressions. Fortunately, I was in possession of abundant data for this particular inquiry since, in addition to many years' observations of my own, I received monthly reports from several very careful and reliable observers in different parts of the British Isles and of the Continent. In these reports the filature of the upper clouds was determined by recording the V point,[1] or point at which a belt of cloud passing through the

[1] I have adopted the expression V point both because the letter V is suggestive of lines converging downwards, and because the expression as an abbreviation of "vanishing point," has the advantage of implying the optical nature of the phenomenon of converging bands.

zenith will reach the horizon, or at which belts equidistant from the zenith would converge at the horizon. In 1876 I was preparing (as mentioned in the *Meteorological Magazine*[1] for that year) a table showing the mean direction of filature of the upper clouds; but as a considerable class of instances recorded in this table presented anomalies for which I could not then altogether account, I deferred its publication. By doing so I have been enabled greatly to add to the number of observations, as well as to increase their general accuracy, and further to offer what I think a reasonable explanation of the anomalies referred to. Before giving this table it will be well to make two statements with regard to the apparent velocities recorded in it.

It seemed necessary, in view of the small amount of time which observers in general could give to this class of observations, to adopt some very rough and simple scale of velocity. There are very few men who, like Dr. Vettin, are possessed of both time and patience requisite to determine accurately the velocity of movement of the clouds. I therefore adopted the scale 0—3; by 1 signifying slow motion, by 2 moderate, and by 3 rapid. For the use of such observers as would undertake observations of tolerable accuracy, I suggested a few years ago a determination of the velocity of the upper clouds according to the time occupied in the transit of the cloud through 15° to or from the zenith. It is obvious that this scale leaves much to be desired, and determinations of the velocities of the upper clouds made by the camera, according to Dr. Vettin's system or by other means, will be of great interest and value, if any Fellows of this Society can be found ready to undertake them. In the mean while it is necessary to utilise the observations already made, however rough the scale employed.

That form of upper cloud which instead of being drawn out in long lines or fibres extends in a bent or twisted wisp, to which I wish the name "Cirrus" to be exclusively applied, has a much smaller range of velocity than the linear cloud which I call Cirro-filum. The mean velocity of Cirrus according to the rough scale employed is 1·17, while that of Cirro-filum is as much as 2·02. But further, I believe that none of the very high velocities are ever obtained by simple Cirrus. I have a small number of reports of force 3 when no V point is given, and when, therefore, it might be assumed that there was no distinct filature of the cloud from which the V point might be determined. Some of these instances are probably due to the observers neglecting to insert the mark of interrogation in the space allotted to V point on the schedules of observation, while others (from the state of the weather at the time) I conclude to be due to the observers mistaking some of the clouds which I denominate Pseudo-cirri for the true mare's-tail, or "curl" cloud. These Pseudo-cirri float at a comparatively low elevation, and therefore appear to move rapidly. I have never myself seen a true Cirrus moving with any very great velocity. This remark may appear to be of little consequence, but it will help to explain, as I shall presently show, the structure of Cirro-filum.

[1] Vol. XI. p. 4.

Table I. gives the number of instances in which Cirro-filum moved from different points of the compass, the mean velocities of movement in these instances, and the mean "angle of filature," that is, the mean angle between the direction of movement and the direction of filature, this angle being regarded as positive when the V point lay to the right of the point from which the clouds moved, and as negative when it lay to the left.

Table II. shows the percentages of the angles of filature, expressed in points of the compass corresponding to the three velocities.

TABLE I.

Direction from	No. of Instances.	Mean Velocity.	Mean Angle of Filature.
			°
North and NNE	221	1·97	+15
NE „ ENE	54	1·53	+ 6
E „ ESE	61	1·45	− 2
SE „ SSE	149	1·70	− 8
S „ SSW	385	2·08	− 4
SW „ WSW	836	1·92	+ 7
W „ WNW	882	2·21	+ 6
NW „ NNW	712	2·02	+ 6

TABLE II.

Estimated Velocities.	Percentages of Angles of Filature, in points of the Compass.							
	−6	−4	−2	0	+2	+4	+6	+8
1	11	13	7	21	19	6	12	11
2	2	2	12	53	21	4	3	2
3	..	1	8	79	12	..	..	..

The conclusions to which these tables lead may be thus summarised. First, a longitudinal motion of the threads is very greatly predominant over a transverse motion. I have always found that the beginner usually imagines the threads of Cirro-filum to move transversely. It is possible that this notion may arise from some idea of waves of air as productive of threads, but it is more probably due to the fact that after threads of Cirro-filum have appeared over any part of the horizon, these are frequently propagated rapidly over the sky, so that the observer who has not correctly watched the motions of particular portions of the cloud, is led to suppose them to be actually carried up to, or past, the zenith, by the upper currents of the atmosphere.

Secondly, the positive angles, that is the instances in which the V point is somewhat on the right of the point from which the clouds move, are most abundant when the motion is from some Northerly or Westerly point; while the negative angles, that is the instances in which the V point lies on the left of the point from which the clouds move, are common when the motion is from a South or South-east point.

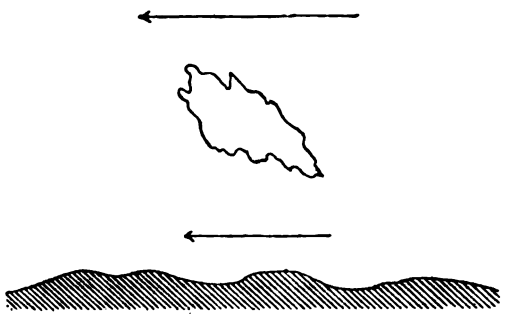
Thirdly, the high velocities are confined to those instances in which the filature is either nearly or quite in correspondence with the direction of movement, and the instances of filature transverse to the direction of movement never occur when the movement is very rapid. The converse, however, of the first of these propositions is not true.

The question now arises on what hypothesis is the structure of these remarkable lines of cloud to be explained? To answer this question, in the first place an examination must be made of the structure of some of those lower clouds which approximate to the same form as Cirro-filum; and secondly, there must be an endeavour to catch Cirro-filum itself in the act of formation. This last attempt, it will be found, can only be made under exceptional circumstances.

It will be seen in a low ill-formed Cumulus, on a day when there is considerable motion in the atmosphere, that its upper portion commonly leans forward in the manner represented in the accompanying diagram (fig. 1.) This form is obviously due to the increase of velocity with altitude. The lowest stratum of the atmosphere is subject to much retardation, arising from the inequalities of the earth's surface; the stratum immediately above that, though less retarded, is subjected to a drag in passing over the sluggish stratum beneath; the layer next above is subjected to less retardation; and the same rule holds good[1] for the higher strata of the atmosphere. In fig. 1, the piece of rag cloud is supposed to be moving from right to left, and the lengths of the arrows above and beneath it represent the relative velocities of the atmosphere moving in this direction. This is observed in about ten out of twelve cases in which this form of cloud occurs. There are, however, instances, especially with North-easterly, Northerly, and North-westerly winds, in which a cloud, seen either in the wind's eye, or in the direction towards which the wind is blowing, possesses the appearance shown in the above diagram. In these instances, it may be inferred (and when there are higher clouds visible at the same time, the inference is found to be correct) that the wind in the head or upper portion of the cloud is from the right hand side relatively to the motion in the lower part. Again, sometimes, as in diagram 2, a cloud having the same figure as before moves in the contrary direction. These

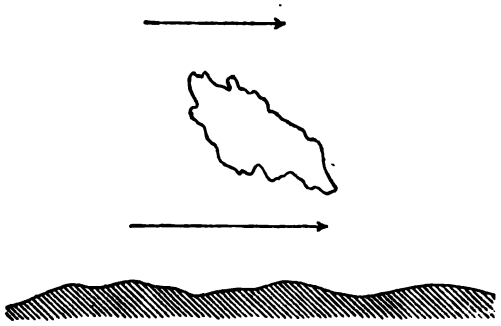
[1] I do not wish to be understood to imply that the increase of velocity with altitude is by any means uniform, or that any formula has yet been devised which adequately expresses the relation between altitude and velocity. In the region occupied by the majority of the stratiform clouds there is a depression in the velocity-curve. Dr. Vettin has pointed out that a relative "slackening of the speed of air motion takes place immediately in the region in which the most active and copious precipitations take place. Intensity of the formation of clouds and the slackening of speed hence appear to stand in connection with one another." This he attributes to the diminution of barometric gradient owing to the heat liberated in the process of condensation. An explanation may perhaps be found in the principle by which Dr. Köppen has endeavoured to explain the increase in the diurnal velocity of surface winds over land; for just as vertical interchange increases the velocity of the lower currents, so must an ascensional current, wherever accompanying the condensation of vapour, cause decrease of velocity in the cloud-stratum.

Fig. 1



instances rarely occur except when the wind has recently changed from a Southerly to a Northerly point, and observations of the higher clouds when made at the same time commonly show that the upper wind still continues to be Southerly. Here, then, it is inferred that the lower portion of the cloud moves more rapidly than the upper portion, although the direction of motion is uniform.

Fig 2



Thus even in the cumuli-forms, which ordinarily tend to the hemispherical shape (being due to the rise of local masses of heated air), a tendency to something distantly approaching the form of a belt is produced by inequalities of velocity and direction at different levels, and the direction or slant of the belt wholly depends on the nature of these differences.

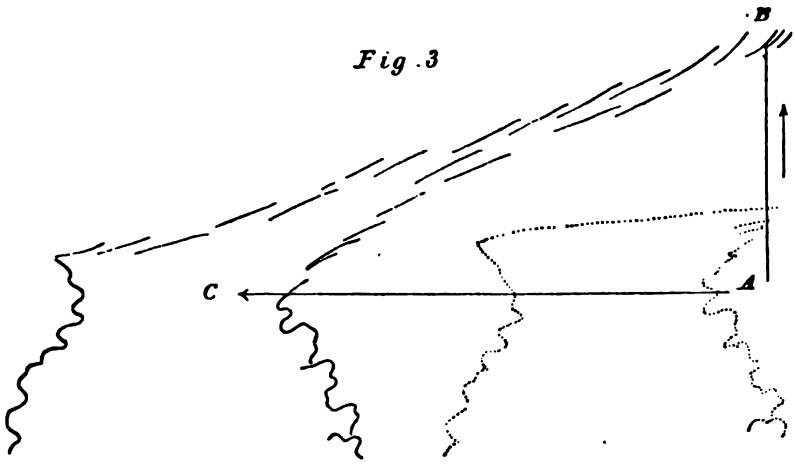
Again, look at the lines of snow which often fall from clouds at a considerable elevation, though much lower than true Cirro-filum. These snow lines (to which I have given the name of "Pseudo-cirrus-Pendulus") are commonly nearly perpendicular at the point where they leave the cloud, but become more and more horizontal towards the tail, that is, towards the place where they are evaporated by contact with the warmer air beneath. It is inferred that the perpendicularity of the front part of these sweepers of snow is due

to their retaining, at the commencement of their fall, the velocity of the cloud from which they are precipitated, and that the fact that their major axis usually coincides with the direction of movement is due to the general uniformity of direction, accompanied by great decrease in velocity, of the strata of atmosphere through which they successively pass. Instances, however, of these Pseudo-cirri frequently occur in which a side twist is given to the lines of descending ice, by a difference of the direction between those upper and lower layers of the atmosphere through which they range. Here there is something which closely approaches the structure of Cirro-filum when the direction of filature is not coincident with the direction of motion, and it would be difficult to believe that the causes of two such similar phenomena are themselves dissimilar.

Cirro-filum is most common around the exterior margin of a system of cyclonic circulation, often at a distance of many hundred miles from the centre of such a system. It is impossible in these cases to watch with any great amount of success the formation of the individual threads. Cases, however, occur in which Cirro-filum is developed in large quantity from a local shower-cloud, during otherwise serene weather; and here it is possible to watch the process of formation without difficulty. Under a summer sky a massive Cumulus begins to form a few miles distant from the observer. The atmosphere being nearly calm up to the height of 12,000 ft. or 14,000 ft. the Cumulus preserves its hemispherical form, and an enormous aggregate of cloud matter is produced, the contents of which may occupy a space of upwards of 100 cubic miles, while the extreme opacity of the cloud shows that the water spherules which compose it are somewhat closely packed. No rain falls from such a cloud while it preserves the hard outline of its upper portions, and its general hemispherical figure. Suddenly the summit of this cloud becomes soft-looking, and spreads out laterally in cirri-form fibres, this change being always simultaneous with the fall of a sheet of rain out of the cloud. The electrical charge which prevented the collision of the particles composing the cloud while these particles remained spherical, has been suddenly diminished in the upper portions of the cloud, as soon as these particles are congealed into ice needles, from the edges and extremities of which the electricity immediately escapes. The particles now only moderately electrified unite, and in their rapid descent absorb the smaller spherules with which they come in contact. The falling rain, and perhaps still more rapidly the disruptive discharges, if such occur, further tend to "tap" the electricity of the cloud, *i.e.* to lower the potential of the cloud-mass; and the shower-making process continues till all or nearly all of the lower portion of the cloud has disappeared. Now in those instances in which there is not only very little motion in the lower layers of the atmosphere but also in the higher, the ice-cloud left in the upper regions of the atmosphere is a true Cirrus, the curls and twisted forms of which are probably due to slight lateral inequalities of pressure produced by the processes of condensation and congelation. A Cirrus so produced may hang nearly motionless for upwards twenty-four hours in the sky, or may more commonly drift very slowly over districts from which the shower which produced it was invisible.

In a large number of instances, however, the upper portion of the cloud does not move uniformly with the lower; and it is quite conceivable that the congelation itself which renders the shower possible, is often due to the penetration of the upper portion of the cloud into a cold current of air. In all such cases Cirro-filum results, streaming off in threads from the summit of the shower-cloud. Whenever the body of the cloud follows the direction of these threads, or moves in exactly the opposite direction, there is no angle of filature; but whenever the body of the cloud moves in a direction which forms a horizontal angle with the direction of the Cirro-filum, the V-point of the latter is no longer coincident with the direction of movement. In the accompanying diagram (fig. 3), which represents what may be not uncommonly seen, the direction of the upper current is such as to carry the thread of the Cirro-filum towards the zenith, in the direction A—B; but during the time occupied by its traversing this distance, the body of the shower-cloud has moved from A to C, and the band of Cirro-filum consequently lies from B to C.

Fig. 3



Now it seems reasonable to suppose that the processes taking place in the production of Cirro-filum around the large area of condensation which forms the front of a barometric depression are, in their main essentials, similar to those which are seen executed in miniature, as above described. It is thus possible to construct, hypothetically, a "triangle of filature" which shall account for the disposition of the cloud bands, whenever these do not move longitudinally. When, however, the point C lies in the straight line A B, the filature of the cloud will correspond with the direction of movement.

These conclusions are in the main in harmony with those at which Herr Möller arrives in his very interesting paper on this subject, as also with those of Dr. Linss, on the origination of cloud streaks.[1]

[1] According to the last-named author, if v_1 represent the direction and velocity of the lower, and v_2 those of the upper wind, "then if the angle between v_1 and v_2 is practically *nil*, a streak can originate only when v_1 and v_2 are different in magnitude,

It happens that the observer is often able to hazard a moderately safe conjecture as to the approximate direction of the movement of Cirro-filum even when visible but for an instant through a break in the lower clouds. For not only are the chances strongly in favour of a longitudinal movement (as is evident from Table I.) but the configuration of the cloud commonly indicates in which of the two longitudinal directions the thread is moving. The commonest appearance of Cirro-filum is that represented in fig. 4, where the heads of cloud appear pointing or curled upward. The explanation of this curvature has been already suggested, and it is obvious (from the general law according to which velocity increases with altitude) that the "heads" which represent the loci of precipitation usually move in advance of the body of the cloud. A remarkable exception to this rule is frequently observed in the rear of a centre of cyclonic disturbance, and I have never observed it elsewhere. Here, after the upper current has changed to a North or North-west point, which commonly occurs some hours later than the corresponding change in the lower current, the posture of the heads of cloud suggests an idea, as in fig. 5, of a movement which is the opposite of the reality, the

Fig. 4

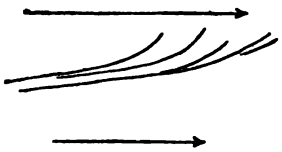
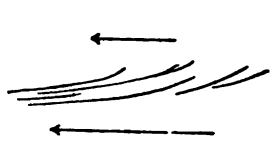


Fig. 5



strands moving from North or North-west more rapidly than the generating loci. This phenomenon, which rarely lasts more than two or three hours, is due to the fact that the winds forming the rear of a cyclonic circulation commence first near the earth's surface, and are the last to embrace the whole region of the cirri-forms.

In noticing the position of the loci of precipitation relatively to the filature, it is desirable after observing a cloud in one azimuth when possible to look at another in the opposite. A lateral twist is not unfrequent in Cirro-filum, in consequence of which portions of cloud which project towards the observer's zenith appear in perspective to be higher than other portions with which they are really on the same level.

Now referring again to Table I. a probable explanation can be offered of the fact that the positive angles are found principally with Northerly and Westerly, and the negative with South-easterly movement. The majority of the Northerly upper currents occur with Westerly surface winds, and a construction of the "triangle of filature" at once shows that in these instances

and then the direction of the streak is coincident with the direction of the wind." It is remarkable, however, that of the sixty-one cases which Dr. Linss has examined there were only eleven in which the angle between v_1 and v_2, if reckoned to 5°, was practically *nil*. Ueber die Entstehung der Wolkenstreifen."—*Zeitschrift für Meteorologie*, vol. xviii. p. 83.

the tail of the cloud will be carried a little to the right of the "head." The Westerly upper currents are common above South-westerly or Southerly surface winds, and the "triangle of filature" here again gives the same result. But the South-easterly upper currents are most commonly noticed in the immediate rear of a South-easterly surface wind, when the under current has already veered to some Westerly point, and before the veering takes place in the upper current. Here a construction of the "triangle of filature" shows that the tail of the cloud will be carried to the left of the head.

The great numerical preponderance of the Westerly over the Easterly upper currents shown in the table is not, I think, more than should be expected. Mr. Ferrel, principally from theoretical considerations, calculates the Eastward component at the level of the cirri-forms as about fifty miles per hour for the latitude of the British Isles, as contrasted with an Eastward surface-wind of about three miles per hour. Resultants obtained from the table in the Paper scarcely show so enormous a difference. Further, in connection with observations of the upper currents, I may be allowed to repeat what I have written on a former occasion: "I believe that the number of observed upper currents from East to North-east points is unduly low as compared with the unobserved. I am led to this conclusion simply from the following fact:—Periods of many days' duration every now and then occur in which the cirri-forms are very rarely visible; and when in the course of these periods an observation can be taken, the upper current is very frequently found to be from an Easterly point."

In conclusion, I would say that in the employment of the name "Cirro-filum," and of some other terms in this Paper, I have not sought any prejudication in favour of my own proposed system of cloud-classification. That system will eventually have its fate decided by meteorologists. I have employed these names as sparingly as I could, and simply because I should have hardly rendered my meaning intelligible without the use of some concise terms. What I have desired to point out is, that the structure of Cirro-filum is necessarily an important element in the prognosis of weather. If the air movements in the higher regions of the atmosphere be regarded as governed by laws precisely similar to those which regulate the movements of the air at the earth's surface, then the filature in a large majority of cases maps out the isobars at the level of the cirri-forms. Nor will its study be lessened in importance by adopting, on the other hand, the conclusions of Köppen, Sprung, and other eminent meteorologists, according to which the movement of the higher clouds is not so much due to differences in the distribution of pressure at the level of these clouds, as to motion previously imparted to them when at a lower level. For the "filature" will still show the actually existing relation between the upper and the lower currents. The value of results of instrumental observations communicated from distant stations by telegraphy is familiar enough to all meteorologists. May I not ask for some attention to messages sent day by day, and year after year, through the silent aerial wires? German meteorologists, with their readiness to accept all the results of honest observation, and their determination to

attack these results by the method of mathematical inquiry, can already claim a priority of discovery in some particulars relating to the interpretation of these last-named messages. I see no reason why this Society should be behind them in these investigations.

DISCUSSION.

Mr. ABERCROMBY agreed in the main with all the conclusions arrived at by Mr. Ley. He himself had all but completed a paper on the subject of the formation of cloud stripes, and his working out of what Mr. Ley called the "angle of filature" agreed with the figures given in the paper. He also gave an illustration of the origin of these stripes drawn from the direction of the smoke left behind by a steamer. He could not hold that it was an extremely rare sight to see a stripe of cloud nearly at a right angle to the wind, as he had often observed a cloud in such a position. There was no necessity for the aqueous vapour in the cirrus to be frozen, though it was so in the majority of cases, as he had seen cirrus-shaped clouds formed low down under conditions of temperature which precluded the possibility of their being ice. He dissented from Dr. Köppen's theory that the diurnal increase in the velocity of the surface winds was due to their intermingling with the upper currents, a theory which Mr. Ley had referred to in the paper as probably correct, because he had observed diurnal increase of velocity when the upper currents were moving slower, and even in an opposite direction to the surface wind. The sudden change in the appearance of the top of a cumulus cloud when rain was about to fall from it, which Mr. Ley had noted, was a valuable observation. He believed that the principles laid down by the author were capable of great extension, and hoped that he would soon lay his results before the Society.

Mr. STANLEY remarked that the upper South-westerly currents which were so prevalent in these islands were possibly part of the compensating currents for the North-east Trade Winds.

Prof. ARCHIBALD observed that the angle of filature might be concisely said to represent the difference both as to direction and velocity between the currents at the upper and lower ends of the filum. He considered Mr. Abercromby's objection to Dr. Köppen's theory of the diurnal increase in the velocity of the surface wind, on the ground that the upper and lower currents were often found to be blowing in different directions, to be palpably unsound, since these large differences were quite independent of the diurnal variations, while even if a retardation of the upper strata did co-exist with an acceleration of the lower, which could scarcely be doubted, it would be almost impossible to observe or measure it with present appliances. He had noticed the spreading out of the top of a cumulus cloud, when about to rain, very frequently in India, and it had always seemed to him to be strikingly analogous to, if not actually identical with, the phenomenon of the cloud cap or table-cloth on mountain peaks and table lands, only that in the former case the cloud was probably warmer than the surrounding air, while in the latter the peak was the condenser.

Capt. TOYNBEE was glad to learn that Mr. Ley's paper was based on careful and numerous observations. He hoped that other writers on clouds would follow his example, and never introduce a new name until it had been proved that the cloud it represented had a decided character and was related to an important state of weather. He found that observers complained of the difficulty they had in distinguishing clouds at the present time, when only about eight forms were given, and sincerely hoped that no new name would be admitted until it was proved necessary by numerous and careful observations. With regard to the naming of "upper clouds," his practice in talking over the subject with captains and officers of ships was to say, "If you see a high cloud which takes the form of lumps or nodules, call it 'cirro-cumulus.' If a high cloud is evenly spread over the sky, call it 'cirro-stratus.' But if a high cloud is neither lumpy nor evenly spread, call it 'cirrus.'" He feared that by asking ordinary observers for more minute divisions nothing would be gained, and he thought that the direction of motion and speed of high clouds named according to the rough classification just stated would go far to supply the aid to forecasting which Mr. Ley

asked for. He also thought that Luke Howard's definition of nimbus as a "cumulo-cirro-stratus" agreed with Mr. Ley's detailed account of the same cloud.

THE PRESIDENT (Mr. LAUGHTON) pointed out that Table I. scarcely supported Mr. Stanley's remark that the upper currents over these islands appeared to be a compensating current for the Trade Winds of the Northern Hemisphere. Such a current would be necessarily from the South-west, whereas the Table referred to showed a very large preponderance of upper current from the North-west quarter.

Rev. W. CLEMENT LEY, in reply to Mr. Abercromby's remark that cirrus was not of necessity frozen vapour, said that probably Mr. Abercromby and himself might be agreed as to whether any cloud which they might see consisted of frozen or unfrozen particles, although they would differ as to the names to be applied to such clouds. He could not altogether agree with Prof. Archibald's remarks as explanatory of the lateral expansion of the summits of shower-clouds. As regarded Mr. Stanley's idea of the upper current over these islands being a compensating current for the Trade Winds, he admitted that our Westerly winds altogether might be so regarded. The Northerly component of our prevailing upper currents, which blew somewhat off the Polar depression area, was the compensation of the Southerly component of our surface winds, which inclined somewhat into that area.

NOTES OF A SECOND SERIES OF EXPERIMENTS ON THE DISTRIBUTION OF PRESSURE UPON FLAT SURFACES PERPENDICULARLY EXPOSED TO THE WIND.

By RICHARD H. CURTIS, F.R.Met.Soc.

[Read June 20th, 1883.]

IN the present Paper I propose to give the results of some further experiments on the distribution of wind pressure on flat surfaces perpendicularly exposed to it, in continuation of those described in the former Paper on the subject by the late Mr. C. E. Burton and myself.[1]

By the sudden death, however, of my coadjutor last summer, the observations which he had been previously carrying out have been lost, and I have been deprived of his valuable help in carrying on the investigation.

The methods of experimenting and the form of apparatus used in these later experiments were in all respects except one the same as before. The single exception was in the method of mounting the plates. Owing to the inconvenience of supporting large plates on a tripod stand, their mounting was modified in the following manner:—

Two trestles, each 2 ft. 9 ins. high, were placed on the ground about 7½ ft. apart and parallel to each other, and upon them two 11-inch planks 10 ft. long were laid side by side, but with a space, usually of an inch or two, between them. Upon these planks, and near their windward edge, the plate to be investigated was placed, standing upon narrow feet fixed transversely to the plane of the plate, by iron brackets at or near each of its lower corners.

In this way the plates were raised sufficiently above the planks to allow of

[1] *Quarterly Journal.* Vol. VIII. p. 139.

as free an escape of air at the bottom as on all the other sides. The square plate of 16 ft. area, the results for which were given in the first Paper,[1] was mounted in this manner, as well as the three plates used in the present series of experiments. The small square plates of 1 ft. area, which were first experimented with, were however mounted on a tripod stand, and I thought it advisable to mount a similar plate upon the trestles in order to ascertain the effect of that method of exposure. The results obtained are given in Table I., and are shown graphically in Fig. I. On a comparison of this diagram with Fig. V. in the previous Paper a close agreement between the two results will be perceived. This is satisfactory, not only because it proves that the later plan of mounting the plates is free from serious defect, but also because of the general support it gives to the methods employed in these experiments,—the observer and all the apparatus being entirely different in the two series. The other plates which have been experimented with, and the results for which are given in this Paper, are a square plate of 6¼ sq. ft. area, and a circular plate of 2 sq. ft. area.

The mean results for these two plates respectively are given in Tables II. and III., and show for the 6¼ ft. plate a system of pressure-lines differing

TABLE I.

RESULTS FROM PLATE (SQUARE) 1 SQUARE FT. AREA.

Hole.	Ratio of distance of Hole from Centre to distance from Centre to edge of Plate in same direction.	Mean Reading.	Mean Reading for Group of Holes similarly situate on Plate.	Number of Observations.
A 1	0·25	0·90	0·93	26
C 1	·25	·94		25
E 1	·25	·96		26
G 1	·25	·93		45
A 2	0·75	0·75	0·78	26
C 2	·75	·79		28
E 2	·75	·74		25
G 2	·75	·83		49
B 1	0·36	0·89	0·93	47
D 1	·36	·94		28
F 1	·36	·94		26
H 1	·36	·94		26
B 2	0·71	0·79	0·82	45
D 2	·71	·83		28
F 2	·71	·83		24
H 2	·71	·85		25
				499

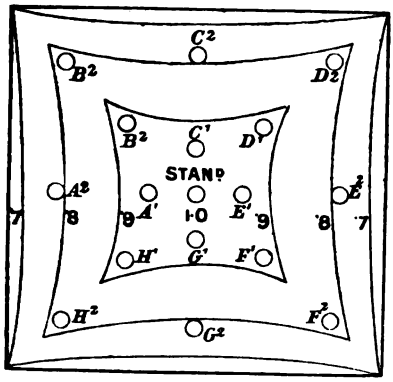
TABLE II.

RESULTS FROM PLATE (SQUARE) 6¼ SQUARE FT. AREA.

Hole.	Ratio of distance of Hole from Centre to distance from Centre to edge of Plate in same direction.	Mean Reading.	Mean Reading for Group of Holes similarly situate on Plate.	Number of Observations.
A 1	0·25	0·95	0·96	54
C 1	·25	·95		57
E 1	·25	·98		53
G 1	·25	·95		49
A 2	0·75	0·85	0·84	50
C 2	·75	·86		77
E 2	·75	·82		51
G 2	·75	·83		78
B 1	0·36	0·95	0·93	50
D 1	·36	·91		54
F 1	·36	·93		51
H 1	·36	·93		53
B 2	0·71	0·84	0·84	50
D 2	·71	·82		49
F 2	·71	·85		51
H 2	·71	·84		51
				878

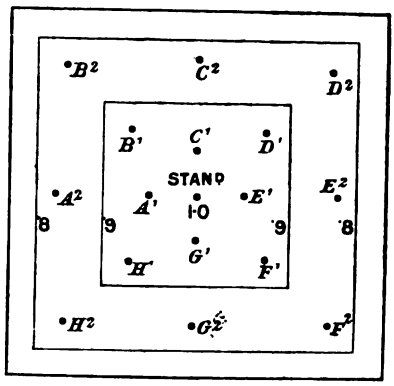
[1] *Quarterly Journal.* Vol. VIII. p. 144.

FIG. 1.



Map of Pressure Lines on Plate 1 ft. square.

FIG. 2.



Map of Pressure Plate on Lines 2½ ft. square.

TABLE III.

RESULTS FROM PLATE (CIRCULAR) 2 SQUARE FT. AREA.

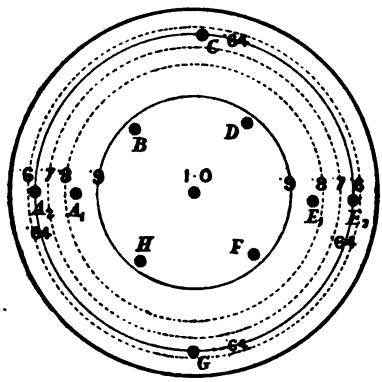
Hole.	Ratio of distance of Hole from Centre to distance from Centre to edge of Plate in same direction.	Mean Reading.	Mean Reading for Group of Holes similarly situate on Plate.	Number of Observations.	Hole.	Ratio of Distance of Hole from Centre to distance from Centre to edge of Plate in same direction.	Mean Reading.	Mean Reading for Group of Holes similarly situate on Plate.	Number of Observations.
B	0·49	0·92		71	A 2	0·88	0·59		74
D	·49	·93	0·92	73	C	·88	·70	0·64	72
F	·49	·92		72	E 2	·88	·65		73
H	·49	·90		73	G	·88	·63		75
A 1	0·66	0·76	0·80	24					
E 1	·66	·84		28				Total..	605

somewhat (Fig. III.) from that obtained from the square plate of 16 ft. area, and still more from that given by the square 1 ft. plate. The contour of the lines is in this case parallel to the edge of the plate, and the 80 per cent. line falls relatively about midway between the positions it occupied on the two former plates. On the round plate the area bounded by the 90 per cent. line is relatively rather larger than on the square plates, and the decrease of pressure near the periphery of the plate appears to be more rapid.

Besides investigating the distribution of pressure upon the surfaces of the plates, experiments have been made to determine the relative central pressure on each plate. The results are given in Table VI.

The statement has often been made that high wind-pressures—say 40 lbs. and upwards per sq. ft.—have only been recorded by anemometers having pressure plates of small area,—1 or 2 sq. ft.; and that large plates fail

FIG. 3.



to indicate these exceptionally high pressures. The present experiments, however, show that the central pressures are practically the same on all plates ranging in area from 1 sq. ft. to 16 sq. ft., and on round as on square plates; and also that the mean pressure per unit of area is greater on a large plate of 6¼, or 16 sq. ft. area than on a small one of only 1 or 2 sq. ft. area—results which certainly do not seem to support the statement just referred to.

Assuming it to be the fact, however, that an anemometer having a large pressure-plate will not indicate such high pressures as those shown by a similar instrument similarly situate, and differing from the first only in having a small pressure-plate, then two possible explanations suggest themselves :—1st. That the area of a gust of wind is small compared with that of the larger plates; and 2nd, and more probably, that the currents of air passing the edges of a plate, and dragging away the air at its rear, produce a much greater effect upon the small than upon the large plates, and in that way more than compensate for the lower mean pressure on the front surface by the greater defect of pressure produced at its back. No attempt has, however, been made in the course of these experiments to investigate the partial vacuum at the rear of a plate caused in this way, although it would seem in the case of the round plate that its form materially affects the result.

Some experiments were made on one occasion to determine the distribution of pressure on the surface of the 1 ft. plate when placed at an angle of 45° to the direction of the wind. The holes A_2, C_2, E_2, and G_2, only were tested; A_2, being the hole on the windward edge of the plate, and E_2 the hole on the edge directed away from the wind; the mean result given in Table V. shows a considerable augmentation of pressure at the hole on the windward edge above that shown when the plate is in its normal position, while at the leeward edge there is a decrease of pressure, but to a much smaller extent. At the centre of the upper and lower edges the relative pressure is very little changed from that observed when the plate is in its normal position.

Table IV. gives the results obtained from a short series of experiments made by comparing the pressure at the holes on one edge of the 1 ft. plate *inter se*. The centre hole A_2 being taken as a standard, a direct comparison was made between it and B_2 and H_2, with the result of confirming the values previously obtained for those holes.

TABLE IV.

Comparison *inter se* of pressure at Holes on edge of Plate (Square) 1 ft. area, A2 being taken as the Standard.

Hole.	A 2	B 2	H 2
Mean Reading	1·00	0·98	0·98
No. of Observations	..	18	21

TABLE V.

Results from Plate (Square) 1 ft. area placed at an angle of about 45° to Wind.

Hole.	A 2 Windward.	E 2 Leeward.	C 2.	G 2.
Mean Reading	1·30	0·64	0·81	0·85
No. of Observations	22	21	19	23

TABLE VI.

Comparison of Central Pressures on Plates of different Areas and Shapes.

Hole.	Circular 2 sq. ft. area.	Square 16 ft. area.	Square 6¼ ft. area.	Square 1 ft. area.
Mean Reading	1·00	1·09	1·11	1·02
No. of Observations	..	49	51	51

TABLE VII.

Percentage of the Total Area of the Pressure Plates enclosed between the lines of equal pressure shown in Figs. I., II., and III.

Plate.	Percentage of Area.			
	90	80	70	60 Edge of Plate
Round Plate of 2 square ft. area	28	20	18	17 17
Square Plate 1 square ft. area	18	36	36	10 Edge of Plate.
,, 6¼ ,, ...	25	46	29	Edge of Plate.
,, 16 ,, ...	19	55	26	,,

(For fig. showing pressure lines on 16 ft. plate see previous paper, *Quar. Jour.* Vol. III. p. 144.)

All the observations from which the tables of mean results given with this Paper have been obtained were made by Mr. Dowson, F.R.Met.Soc., of Geldeston, to whom I was previously indebted for the long series of observations upon which the results for the square plate of 16 ft. area were based.

The observations comprised in the present series number 2,257.

DISCUSSION.

Mr. Dines referred to some experiments he had made on wind pressure, which consisted in exposing to the wind boxes loaded with certain known weights, in such a manner that if the wind were sufficiently strong they would be overturned. The greatest weight the wind had ever overturned was 9½ lbs., the dimensions of the box containing this weight being 12 × 6 × 6 ins.

Professor Archibald remarked that it would be interesting, while measuring the pressure in front of the board, also to measure the amount of drag or vacuum behind the board, and so get the actual total pressure to which boards of different shapes and sizes would be exposed in a wind.

On the Reduction of Wind Records. By the Hon. Ralph Abercromby, F.R.Met.Soc.

[Read June 20th, 1883.]

The materials for the reduction proposed in this paper are supposed to have been obtained from anemographic records, similar to those given by the Kew instruments, after they have been tabulated for every hour. It is proposed to obtain the value of the following items:—

1. Q, the total quantity of wind;
2. q, the quantity from different points of the compass;
3. F, the frequency of different winds;
4. V, the mean velocity;
5. v, the diurnal variation of velocity;
6. y, the mean velocity from different points of the compass;
7. R, the resultant;
8. D, the mean direction; and
9. d, the diurnal variation of direction.

The physical significance of these different items will now be discussed *seriatim*, and the best methods of obtaining them.

Q, the total quantity of wind for any desired time is simply the number given by the counter of a Robinson's anemometer for the required period. This item measures the comparative windiness of a place, or time; but in practice the numbers are so large that it is seldom used.

For instance, at Liverpool the average number of miles run in a year is 114,050.

q, the quantity from different points of the compass is got directly from the tabulations, by adding up the quantities found under each direction for any time required. Of itself q does not give much information, for the direction which has the largest quantity may be either the most stormy or the most frequent wind, but it is indispensable for finding y and R.

F, the frequency of the wind from as many points of the compass as may be considered necessary, is found directly from the tabulations by adding up the number of hours or days that each wind blows, independent of its velocity. This is one of the most important items as an element of climate, especially for navigation. When the frequencies are arranged in a diagram, radiating from a centre in the proper direction, the well-known "wind rose" is obtained.

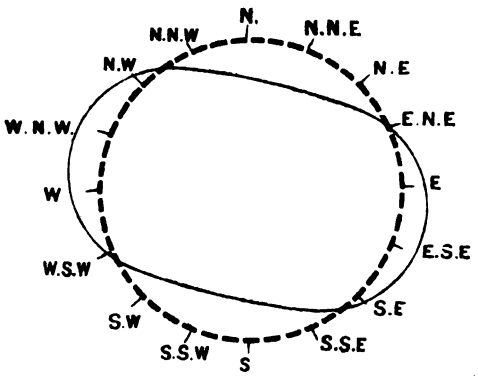
V, the mean velocity for any time t, is got directly from the tabulations by the equation $V = \frac{Q}{t}$, where Q is the total quantity for the time desired. Like Q, it gives the measure of relative windiness; but being in practice a much smaller and more convenient number, it is invariably employed for that purpose. Thus at Liverpool the mean velocity for the year is 12·33 miles an hour.

v, the mean diurnal velocity, is got from the tabulations by adding all the quantities recorded at the same hour, and taking their mean value. This is

an important and interesting item, and must not be confounded with the mean diurnal resultant.

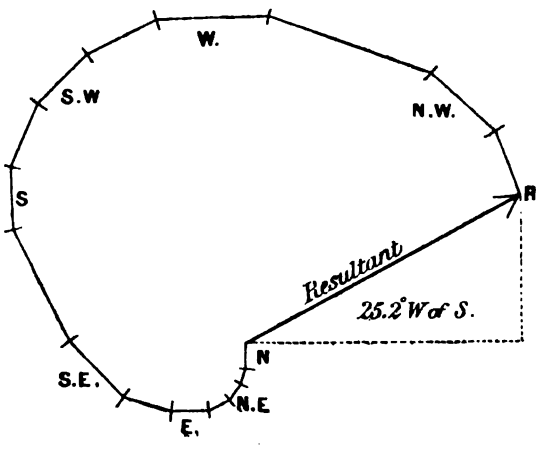
y, the mean velocity from different points of the compass, is found by the equation $y = \frac{q}{F}$ where q is the quantity, and F the frequency. This item gives the most stormy quarter, and need not coincide with F or q. As the force of wind is some function of its velocity, Archibald Smith's name "dygogram" (force-angle-diagram) has been suggested by Mr. Rundell to distinguish this item, and his dygogram for Liverpool is given in Fig. 1. The dotted circle represents the mean velocity from all quarters, and therefore shows y very clearly.

Fig. 1.



R, the resultant, is ascertained from q by treating the different quantities as if they were forces radiating from a point, and combining them by the parallelogram of vectors, or else as a polygon of forces. In Fig. 2 is given the resultant polygon for Liverpool, as deduced by Mr. Rundell, for the whole year. This is also the item given by the wind-component integrators, of which several forms have been brought out of late years.

Fig. 2.



Now as to the physical significance of the resultant, it is manifest from an inspection of the Liverpool diagram that the resultant is a positional, and not a quantitative measure, so that no deduction can be drawn from its magnitude as to either the mean direction or velocity of the wind. Take for instance the extreme case of 120 miles of a Northerly land breeze being succeeded by 120 miles of a Southerly sea breeze. The resultant is N—S=0, the equation to the origin, which simply means, that if a balloon had been blown 120 miles out to sea in the morning, it would have been blown back to the place it started from by the evening sea breeze. Thus it is clear that the resultant may be described as the "balance of the backs and fores of the wind;" and this seems to have been the idea of the meteorologists of the commencement of this century, who considered that it was hopeless to follow the apparently fickle changes of the wind, and who looked on the resultant as giving the balance of the flow of air past any place for a year or shorter period, from which perhaps some laws of atmospheric circulation might be deduced. This resultant has been calculated for a large number of places, but the Author does not think that any very important facts have been thereby discovered.

D, the mean direction of the wind.

Before describing the methods of obtaining this item, it may be expedient to consider what the mean direction of the wind really is.

In Fig. 6, where the direction and velocity traces at Kew are given for three consecutive days, looking at the direction trace for the first day, it is clear that a straight line might be drawn parallel to the base, on which the diurnal variation would be nearly symmetrically superimposed.

This line would certainly be the mean direction for the day, and would have the same physical significance as the mean level of a tidal ocean.

But if, as on the third day, the wind suddenly shifts nearly 90° about 2h. a.m. it is difficult to say what the mean direction is. If a lake discharged itself into the sea by a waterfall, what significance would the mean level of the land between the summit of the fall and the sea level possess? Take also the extreme case before mentioned, with equal frequencies, instead of equal quantities, of opposite winds with land and sea breezes, what is the mean direction for the day? There are, however, three mathematical processes for treating lines meeting at a point, which present analogies to wind, which it will be worth considering, in case they may throw any light on the idea of mean direction.

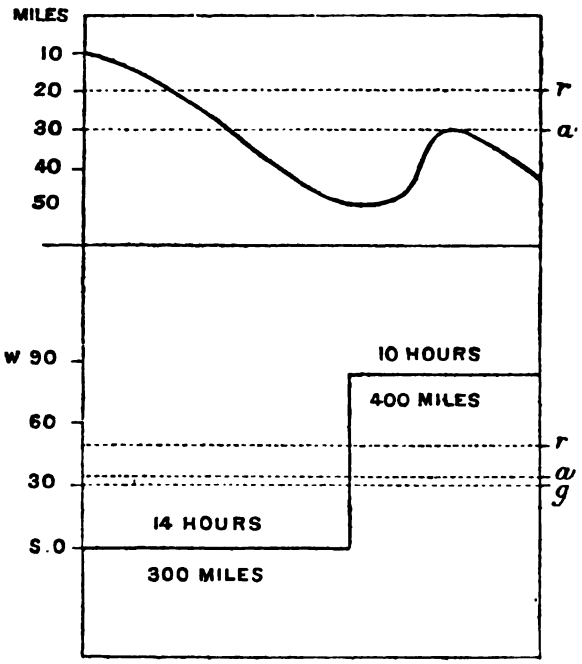
These are *r*, the resultant;

g, the geometrical, and

a, the arithmetical.

The best way of illustrating these methods will be to take an ideal case, and treat it by all three, so as to compare the results. Fig. 8 is a simplified and exaggerated diagram of the wind direction for the 24 hours from noon August 7th to noon August 8th, as shown in Fig. 6. The velocity curve in the diagrams has no resemblance to that in Fig. 6. Here the wind is supposed to blow for fourteen hours from the South, with a quantity of 800

Fig. 3.



miles, and then to shift suddenly to the West for ten hours, with a quantity of 400 miles. Combine these numbers as a resultant, Fig. 4, and a direction is obtained 53° W. of S., and a quantity of 500 miles for the day marked *r* in Fig. 3.

The author has already shown what the significance of this resultant is; but on coming to consider it as the mean direction for the day, it will be found to represent a direction from which the wind never blew at all, and that to get it velocity and direction, which have nothing to do with each other, have been compounded. The effect of this is very clearly shown in the resultant velocity, which is only 21 miles an hour, instead of 29 miles, the true arithmetical velocity. This seems to be the most unsatisfactory method of deducing the mean direction.

Next by *g*, the geometrical method, the frequencies of the different winds are combined, as in Fig. 5, by the parallelogram of vectors, but without any consideration of velocity. In this case a direction is obtained about 35°½ West of South marked *g*, in Fig. 3. As in the case of the resultant, this is a direction from which the wind never blew, but is so far a better representation that it is compounded of pure direction. The method fails when the frequencies are equal and opposite to one another.

Lastly by *a*, the arithmetical method, the mean number of degrees, measured from the base of all the hourly tabulations, is taken. Here there

FIG. 4.

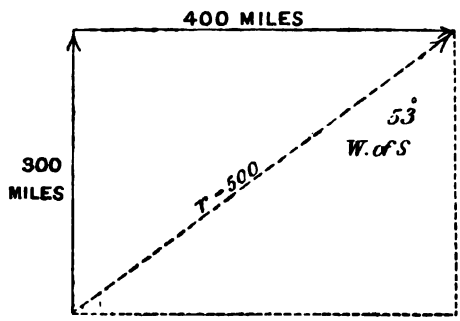
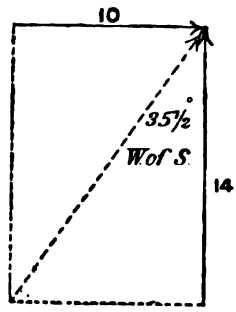


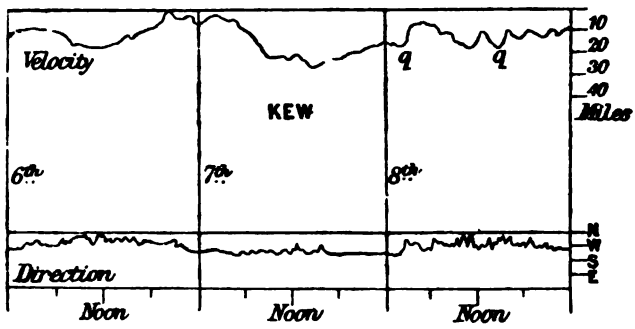
FIG. 5.



are fourteen hours at 0°, and ten hours at 90°, or $\frac{9 \cdot 0 \cdot 0}{2 \cdot 4} = 87\frac{1}{2}°$, as marked *a* in Fig. 8. The close agreement with *g* in this case is purely accidental.

This is the same value which would be ascertained by dividing the area of the curve, as obtained from a mechanical integrator, by the length of the base line. Like the other two methods, this gives a direction from which the wind never blew, and fails sometimes when the wind is shifting between North-north-west and North-north-east, unless 360° be added every time the trace passes the upper North line.

FIG. 6.

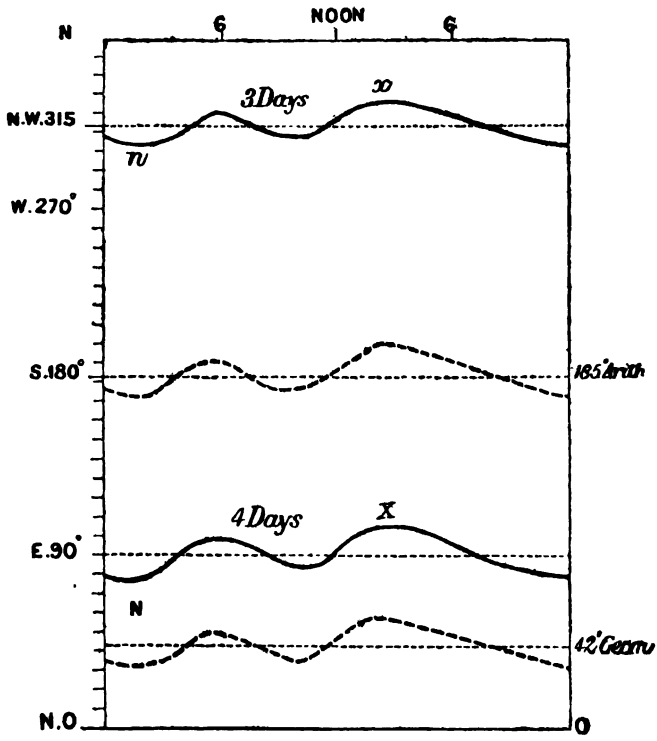


August 6th to 8th.

Considering, then, all the mathematical results, it cannot be said that they assist in any way to a conception of mean direction, and it almost seems that variable winds are among those things in nature which cannot be added, and must simply be recorded as "variable." In this country probably about 20 per cent. of days would be so recorded, while the remaining 80 per cent. would belong to a type to which a definite direction could be attached. If a mean direction is wanted the arithmetical method, being the simplest, is certainly to be preferred.

Lastly *d*, the diurnal variation of direction. This may be best discussed by considering Fig. 7. Here the wind is supposed to blow for four days from

Fig. 7.



East and then for three days from North-west, and it is assumed that a similar amount of diurnal variation is superimposed on each day, as shown by the full line. If the separate directions are combined geometrically, a mean is got of 42°, and if arithmetically a mean of 185°, as shown in the figures from North. It is also clear that whichever method is adopted the difference between the two sets of maxima, X and x, and the two sets of minima, N and n, will be practically the same, and that, therefore, the diurnal variation will be given correctly, though the mean direction or level of variation will differ largely. As both mean directions are to a certain extent analytical fictions, and, therefore, of about equal value, the arithmetical method is to be preferred as being much the simplest. If the amount of variation with the East wind was not the same as with the North-west wind, then the mean variation given by the two methods would not be the same, but the difference would not be great. Most recording anemometers, such as those at Kew, give a direction trace independent of velocity as it really is in nature. The arithmetical method gives the mean value of this curve, free of all complication with velocity, as in the resultant method.

Such are the principal items which it seems desirable to obtain in reducing

any series of wind records, and it becomes a question whether it is worth while applying harmonic analysis or any other mathematical treatment to the results. Consider the genesis of a statistical curve. In the first place, a glance at a series of wind curves, as in Fig. 6, will show that wind like temperature has no definite diurnal amount, and that therefore there is no absolute physical constant to be discovered, but only an arithmetical result which can be obtained. Also, that it is extremely improbable that all the greater changes will ever exactly balance out, so that some of the minor flexures of the mean curves will only represent unbalanced numbers, and not a real physical phenomenon. In the second place, the whole theory of averages depends on the principle that when the general fluctuations are averaged out there is only one diurnal variation left. But in practice, with wind direction, there are often two near the coast, viz. ordinary and land and sea breezes. These get mixed up in the result, and cannot be eliminated. For instance, at Liverpool the diurnal variation of direction is normal during ten months of the year, that is to say, the wind veers with the sun, and backs at night, but in autumn local land and sea breezes invert the rotation. If, then, it be attempted to express the variation for the whole year in a harmonic series, it can doubtless be done, but that involves the idea that the function is continuous, which it is not, and the series represents a geometrical fact, but not a physical phenomenon.

It cannot be said that harmonic analysis has as yet added much to our knowledge of meteorology, and the author doubts if there would be much advantage in applying any further mathematical treatment to the items obtained in the manner suggested in this paper.

In considering the diurnal variations of wind, the most important point is to discover the relation of a change in velocity to a change in direction. To do this it is obvious that the two variations must be kept entirely separate. Unfortunately, in almost all the reductions which have been carried out in this country, the two have been compounded into the resultant velocity and direction for each hour of the day; and either the curves of diurnal resultant velocity and direction, or else the diurnal values of the components of the resultant at each hour, have been taken as representing the diurnal variation of the wind. This, however, is manifestly not the case, for each curve or component is a mixture of velocity and direction. This error is entirely obviated by the arithmetical method advocated in this paper.

For instance, in the diurnal curves of resultant velocity and direction in Orkney, as published in the *Quarterly Weather Reports*, and given in a diagrammatic form by the author in his paper, "On the Diurnal Variation of Wind and Weather in Relation to Isobars,"[1] the direction curve shows a flexure about 10 a.m. corresponding with a similar flexure in the velocity curve. It is impossible from the method employed to say whether there is a real diurnal variation of direction at that hour, or whether it is only the reflection of the diurnal increase of velocity introduced in making the resultant.

[1] *Quarterly Journal*, vol. viii. p. 213.

An example of the difficulty of assigning a real mean direction to the wind in certain cases may be found in the following. Supposing that it was wished to trace the connection between deaths from diseases of the chest and the direction of the wind for a week. A very possible case would be to have four days of South-west wind, followed by three days of North-east wind. By every method the mean direction for the week would be a long way from either point, and hence any deductions drawn from such results would be fallacious.

The author feels that some apology may be necessary for laying before the Society a scheme of wind reduction, of which no part is absolutely new, though perhaps there may be some novelty in the way in which the deductions are combined. He is encouraged to do so, however, by the fact that similar papers have been acceptable to the Society, and because he cannot think that the method of components, hitherto used almost exclusively in this country, is that which gives the best results.

SUMMARY.

In this paper the author discusses the significance and best method of deducing—1. The total quantity of wind; 2. The quantity from different points of the compass; 3. The relative frequency; 4 and 5. The mean and diurnal velocity; 6. The mean velocity from different quarters; 7. The resultant; and 8 and 9. The mean and diurnal direction of the wind.

DISCUSSION.

Prof. ARCHIBALD considered that the author unduly underrated the value of the resultants. In Vol. I. of the *Indian Meteorological Memoirs* occurred some papers by Chambers, Blanford, and others, in which both harmonic analysis and the resultant were freely used, and with remarkable success. He did not himself see how such results could have been achieved without employing the resultant. For rough practical purposes Mr. Abercromby's methods might do, but for scientific analysis it would be most injudicious to omit the calculation and use of the resultant.

Mr. C. HARDING was of opinion that many of the objections raised by the author to the system of wind reductions might be met by the use of components. He was struck by the little notice which had been given in the paper to this method of discussion. He could not see why the author gave the preference to the arithmetical rather than to the geometrical process: both seemed about equally objectionable. Mr. Rundell had applied the harmonic analysis to the winds of Liverpool, and the whole system of discussion was one of considerable promise, and might with advantage be followed by other meteorologists. It was, however, a pity that the materials used were not better, since the observations were greatly influenced by the valley of the Mersey. He thought the paper fell a long way short of the present requirements of meteorology.

Mr. ABERCROMBY, in reply, said that his primary objection to the resultant of wind was that it was a hybrid curve, and gave neither velocity nor direction correctly. All instrumental records, such as those published in the *Quarterly Weather Reports*, gave them separately as they really occurred in nature. The arithmetical method of reduction advocated by him gave the mean value of each of the direction and velocity curves as they appeared in those reports, while in a resultant curve the two would be inextricably mixed up together. In his condemnation of the resultant he, of course, included the method of taking each of the components of that resultant separately, and drawing conclusions

from its annual or diurnal variation. In both the Bombay and Liverpool reductions, where at one season of the year land and sea breezes modified the ordinary variation of wind, the annual variation of any component gave a geometrical result, but one which had no physical significance. Another serious objection to components was the extremely complex manner in which it gave even the resultant. For instance, in trying to obtain the diurnal direction of the wind at Liverpool he could only discover two tables of North and East components, and as to arrive at a knowledge of even the resultant direction from them required a troublesome calculation, he could not think that that was the best way of reducing wind. The method proposed in the paper would have given the true variation in a very simple manner. He thought the Liverpool reductions very valuable, and he did not believe that it was a defect that they reflected the local peculiarities of the station. His objection to harmonic analysis, as applied to wind, was that it gave nothing which could not have been obtained much more easily. Wind velocity curves, whether real or resultant, showed, besides a principal maximum related to the diurnal variation of temperature, smaller fluctuations whose periods coincided with the diurnal variation of the barometer. Now if one of these curves were represented approximately by a harmonic series, no doubt the values of the coefficients would show that the curve had flexures corresponding to those of the barometer; but as much might be seen at a glance by mere inspection of the plotted curves. Neither, of course, afforded any clue to the physical nature of the connection, beyond the inference that if both varied at the same hour they most probably had some cause in common. The object of all reductions was to exhibit physical laws in the simplest possible form, and he could not help thinking that some of the elaborate reductions which had been made by the method of components clouded rather than cleared diurnal phenomena, which were capable of being presented more distinctly by an easier method.

The Spectroscope as an Aid to forecasting Weather. By Frederic W. Coby, M.R.C.S., F.R.Met.Soc.

[Read June 20th, 1883.]

I shall commence this Paper by giving a short history of the rain-band, which, although not the only phenomenon in the spectrum to be taken into account in foretelling weather, is yet the most important. The other appearances I consider have not been sufficiently studied for any decided statement to be made about them. To quote from Mr. Rand Capron's pamphlet—*A Plea for the Rain-band*—"Its history may be said to date from the time when Angström's maps of the solar lines were found to present different aspects according to the condition of moisture of the atmosphere at the time of observation, and when that pioneer of spectroscopy proved the presence and absence of certain lines forming bands in the spectrum, more especially a set near D, to depend on that condition. No practical meteorological result followed, however, until, as Professor Piazzi Smyth mentions, the subject was first presented to him as a marked feature in sky spectrum at Palermo before and after a scirocco in 1872. Next, when in July, 1875, destructive floods in both France and England (not predicted by the barometer) were noticed by him in connection with a peculiar band in the spectrum under dates July 19th and 26th, 1875. Professor Smyth vividly describes in *Nature* (vol. xii. pp. 281, 252) the phenomena then observed, how the dark

band near D was found the forecast of a drenching afternoon following the fine opening of a Scotch holiday in Edinburgh; and how, on another occasion, it became the "spectroscopic *prévision* of rain with a high barometer." Then followed observations in May, 1876, to the same effect in France, especially at Marseilles, where the rain-band was seen in the spectrum, and followed by rain to the surprise of the natives, who consulted only the public barometer and thermometers, and found none predicted. In February, 1878, appeared the xivth volume of the *Edinburgh Astronomical Observations*, 1870 to 1877, and here, under the head of "Meteorological Spectroscopy in the small and rough," the subject has been treated in a most complete and elaborate manner, and illustrated by a set of engravings of spectra. The *Journal of the Scottish Meteorological Society*, N.S., Nos. 51, 52, also contains contributions by Professor Smyth on the subject. Again, in *Nature* of July 1st, 1880, vol. xxii. pp. 194-5, the subject of "Rain-band Spectroscopy" is dealt with in a condensed and epitomised form—very acceptable to the reader, who doubtless will recognise the identity of the 'Edinburgh Experimenter' in this useful contribution on the subject."

The principal rain-band is a dark shading (in spectroscopes of small dispersive power) situated on the red or least refrangible side of the D lines of the spectrum, involving them and at times increasing or decreasing in intensity, and approaching or receding from the C line according to the nearness or quantity of rain. I will not especially refer to my statistics of rain-band and rainfall for last year, as I consider that the system adopted then for forecasting rain was not altogether sound. The observations were for the most part taken in a Northerly direction, and not according to the plan which I discovered about ten months ago, and have since carried out in my chart for the present year, *i.e.* always to observe towards that point from which the wind is blowing; or, if one's knowledge extends to foretelling the probable direction of the wind, from movements of the upper clouds or other signs in the direction from which they are coming, then so much the better will be the success with the spectroscope.

I propose now to give a few instances of the power of this instrument. On the 1st of January of this year, at 9 a.m. the amount of rain-band was 70 per cent. in all directions but the zenith, where it was 60 per cent. The barometer was slightly falling; there was a light breeze from South-west, which gradually veered to West-south-west, and was moderate at 9 p.m. Intermitting slight rain occurred all day and the following night, and the next day at 9 a.m. it amounted to ·158 in. From the 9th to the 18th the rain-band gradually increased and then remained persistently strong. Although a measurable amount of rain fell on the 9th, 11th and 12th, yet, it being out of proportion to the extent of rain-band, led me to prognosticate that a rainy period was about to take place, and on the early morning of the 15th heavy rain fell and again on the 16th; then rain occurred more or less for the ensuing five days, amounting in all to ·588 in. Preceding this wet week the wind was generally Easterly with a gradual depression of the mercury,

afterwards veering to South-westerly and Westerly with a more rapidly rising barometer. Early on the 25th a heavy snowfall occurred to a depth when melted of ·225 in. On the previous day slight snow and hail fell about 9 p.m., the barometer after 9 a.m. began to fall rapidly, and at the morning observation 20 per cent. only of rain-band was observed. I have already stated in a letter to the *Times* of the 7th of February, that as far as my present experience extends the spectroscope does not indicate when snow is to be expected. The rain-band diminishes, generally speaking, several days before snow; it seems that the vapour is transformed into snow crystals, and I have no hesitation in saying that in those cases where, with a low percentage of rain-band rain apparently falls, it is either melted snow or hail. After this snowfall of the 24th and 25th the rain-band began to increase, the barometer being very unsteady, and the wind ranging between a Southerly and Westerly direction. The rainfall measured ·209 in. for the 27th, ·06 in. for the 28th. On the 29th the spectroscope indicated 60 per cent. of rain-band at all points of the compass, and 50 per cent. at the zenith. The wind was South-west with a falling barometer. The sky was not very threatening, although *nimbus* clouds were seen; but three hours afterwards moderate rain began to fall, it continued for about four hours and amounted to ·31 in.

Proceeding to the month of February, on the 2nd, at 9 a.m. with a falling barometer and a moderate breeze from the South, 60 per cent. of rain-band round the horizon, and 45 per cent. at the zenith occurred; intermitting very slight rain followed for several hours, then a downpour at 8 p.m., and slight showers subsequently, reaching a total of ·41 in. From the 1st to the 8th inclusive the mean rain-band was 48·7 per cent., and the rain that followed during the 9th, 10th, and 11th, reached the relatively large amount of 1·351 in. The fall of rain, ·126 in., that occurred on the early morning of the 1st of March was preceded by an increase of the rain-band commencing on the 27th of February; neither the hygrometer, the barometer nor any particular aspect of the sky indicating rain. The rain-band did not exceed 40 per cent., but it was a gradual increase for several days, which looked suspicious of wet. The mean from the 1st to the 14th was 42·5 per cent.; 85·6 from the 15th to the 22nd, about which date the rainy period terminated; and from the 22nd to the 28th the mean percentage of rain-band fell to 80. This gradual descent seemed to foretell the accession of the cold wave, which took place in March. Throughout this month the rain-band was extraordinarily low, the mean for the first fifteen days being only 18 per cent. No actual rain fell during this period, nothing but snow. A heavy fall, ·28 in. when melted, happened on the 7th and 8th, and as usual was preceded by a low rain-band, the spectroscope indicating 10 per cent. on the 5th, and 15 per cent. on the two following days. In the course of these three days the barometer fell rapidly from 30·405 ins. to 29·524 ins. The mean rain-band for the latter half of March increased to 2·37 per cent. A moderate fall of rain, ·109 in., occurred at 4 p.m. on the 30th, the rain-band at the morning observation being 55 per cent. with a Southerly wind, the barometer having fallen rapidly on the preceding day with an increasing

rain-band. From the 1st to the 17th of April the weather was beautifully fine; very slight rain fell on the 14th in the morning and afternoon, but was not measurable. It was interesting to observe with a gradual decrease of pressure the slowly increasing rain-band of 15 per cent. on the 11th to 35 per cent. on the 14th; and in the *Times* of the 16th of April it is mentioned that on the preceding day there were showers in the West and North, and rain was falling at 6 p.m. in Yorkshire. On the 25th of April the rain-band began to increase towards the South and West until it reached 50 per cent. at 9 a.m. on the 27th. Slight rain fell during this day, and heavy rain in the early hours of the succeeding day, amounting to ·57 in. I was surprised to find that 50 per cent. was again visible in the spectroscope at my morning observation on the 28th, leading to the inference that more heavy rain was to fall, as happened early on the 29th, to the depth of ·457 in. My experience is that as a rule heavy falls of rain do not occur within twenty-four hours of each other, and the assistance of the spectroscope in this instance seemed especially valuable. With reference to the other phenomena observed in the spectrum, useful in the foretelling of weather, the F line in dull and calm weather is not very distinct; but generally before wind, especially if unaccompanied by rain, it stands out clear and well-defined. In frosty weather, when the amount of rain-band is low, the calcium and barium lines, &c. in the yellow strip on the blue side of the D lines show out very distinctly. The variations in the dry-air band at the α line between C and D, but which is a little nearer to the former, are very important in prognosticating. It almost disappears before rain, and on the other hand is conspicuous previous to fine weather. At the commencement of the rainless period, at the beginning of April, this band was divided into two parts, the larger on the red side; but it is the only occasion on which this phenomenon has come under my notice. The dark band at C to the blue side of C is a smaller rain-band, to which I do not attach much value. In all instances that I have observed the large shading about the C line diffused or shifted to the extreme red side of C, squally weather, either with or without rain, has happened some hours afterwards. When looking at a fine-weather cumulus cloud the shading at C is slight. It is much darker when a pure blue sky is observed. The gradual diminution of this band is useful in foretelling cumulus clouds. For different directions of wind the spectrum seems to vary, but this I have not satisfactorily worked out yet.

I shall pass on now to two phenomena as regards colour in the spectrum. It will be admitted generally that the colours of the sky-spectrum vary. For instance, the blue is sometimes deep, and at other times lighter and clearer; the yellow strip at the blue side of D has occasionally a greenish hue, and so on. One of these phenomena is a reddish tint of the blue end of the spectrum; this occurs mostly in winter before slight drizzling rain. At first I imagined it was due to a condensation of moisture on either the glasses of the spectroscope, the window, or the reflecting glasses outside the house for observing the rain-band at the zenith, or other part of the sky; but from a few experiments and careful examination it was evidently due to an actual change of colour

in the blue. The other phenomenon was mentioned by a correspondent in *Knowledge*. He states that an apparent overlapping of the green on the blue invariably happens before thunderstorms. It certainly is true that the colour of the violet end is deepened, and the green is rather more prominent, but I should hardly describe it as overlapping.

I herewith append a list of the different percentages observed during the first four months of this year, with the number of times in which rain, snow, or no rain followed. In those cases where slight rain accompanied the snow, with a low percentage of rain-band preceding, I think it may be safely surmised that the snow melted in its passage through a warmer substratum of air before reaching the ground, for as the precipitation increased, the rain stopped and nothing but snow fell; this explanation applies in like manner to hail. The means for this period were computed from the 9 a.m. observations, which amounted to 120 out of a total of about 800 or 900 for the four months. There were two cases of 70 per cent., and rain followed in both; four of 60 with rain in all; two of 55 per cent. and rain in each one; twelve of 50 per cent. and rain in every case; one of 45 with rain; nineteen of 40 with twelve of rain and seven without rain, of which three were followed by overcast skies; four of 35, three with rain, one without; twenty-nine of 30 with eighteen rain, two snow, and nine without; sixteen of 25 with two rain, three cold rain, snow and hail, two snow, and nine no rain; thirteen of 20, one snow and rain, three snow, and nine without rain; eleven of 15, in one of which a few drops of rain followed, the temperature in the screen at the time being 34°·9 dry bulb, 33°·5 wet bulb, one rain and snow, five snow, four none; four of 10, one rain and snow, two snow, one without; one of 40, decreasing to 30 shortly afterwards, no rain but nimbus clouds present; one of 30, increasing to 40, rain ·085 in.; one of 20, increasing to 30 per cent. at 8 p.m., slight rain then heavy snow fall commencing at 9 p.m. I certainly think these results are most convincing.

As an argument against the use of the spectroscope for prognosticating rain, it was once remarked to me that the rain-band is never absent when observing over the sea. That is quite true, and equally so in land observations, I have never found it absent; for although the observer gazes direct at the place where the rain-band is situated in the spectrum, it is quite possible that in cases of low percentage he may not discover it; but, by looking out of the corner of the eye, as the saying is, or a little askew, the shading will become sensible.

I assume it must be merely a matter of educating observers to form correct estimates of the percentage of rain-band. It is a difficulty easily mastered in two or three months by patience and perseverance. It cannot be learnt from books or illustrations, although these will help one a little. I should be very pleased to hear of the spectroscope being used as one of the standard instruments at all of our meteorological stations, for I feel sure that with trained observers the results would be highly satisfactory, and a great many facts be brought to light.

It is apparent to others as well as to myself that there is a void to be filled up in our daily weather forecasts, and which will lead to better success in the forecasting of rain.

DISCUSSION.

Capt. HOFFMEYER said: Il m'a beaucoup intéressé d'assister à cette séance de la Société météorologique de Londres, et notamment j'ai été bien content d'apprendre par les rapports de M. Ley sur les cirrus et de M. Cory sur le spectroscope que la Société s'occupe sérieusement de nous procurer de nouveaux moyens pour l'avancement de cette partie très-difficile de la science météorologique que nous appellons le Service du Temps. C'est une chose bien connue que l'observation des conditions météorologiques dans les couches inférieures de l'atmosphère souvent ne suffit pas pour préciser les prévisions, et il n'y a pas lieu de nous en étonner, puisque ces conditions dependent de tout d'influences locales; pour mieux comprendre ce qui ne passe il faut donc étudier attentivement les conditions moins troublées des couches supérieures. Malheureusement c'est plus facile de le dire que de le faire, et nous devons être bien reconnaissants, quand on nous offre des moyens d'atteindre ce but. Il n'y a aucun doute, que l'observation des nuages et notamment des nuages supérieures sera de la plus grande importance et nous savons tous ce qu'à cet égard, nous devons aux travaux assidus et remarquables de M. Ley. Peut-être la valeur du spectroscope comme indicateur de la pluie est encore un peu incertaine, mais il ne faut pas pour cela laisser tomber ces études tout de suite, nous devons nous rappeler que tout commencement est difficile.

Mr. GASTER wished to ask Mr. Cory as to the meaning of some of the terms employed in the paper. Thus what did the values 10, 15, 20 &c. "per cent." of rain-band mean? What was the unit value? and how was the scale devised? He had used one of the ordinary "pocket" spectroscopes and believed to be a very good one, but had found it impossible to distinguish between 10 and 15 per cent., or anything like so minute a difference in the quantity or density of the rain-band. What form of instrument did Mr. Cory employ? Another point deserving notice was the large per centage of success claimed by Mr. Cory for the indications of his instrument. There was a statement in the paper which threw considerable light on this: Mr. Cory had never seen a spectrum entirely free from rain-band. If that were so, it was obvious that unless there were some limit to the meaning of the band, every fall of rain might be claimed as foretold, the only difficulty being to account for the prevalence of dry weather at all.

Rev. W. CLEMENT LEY expressed a doubt as to congelation being the cause of the small amount of rain-band in the winter season and in March 1883, since cirrus, halos, parhelia, and other effect of congelation were generally admitted to be most frequent precursors of rainfall. The diminution of rain-band in the cold months he considered to be simply due to the diminution of vapour with temperature. Prof. Piazzi Smyth had explained the second minimum of rain-band common about the time of the vernal equinox as due to diminution of warm vapour consequent on the polar winds prevailing about that time.

Mr. SCOTT remarked that the minimum rainfall did not occur exactly at the spring equinox, but, according to the sixty years' average of London rainfall worked out by Mr. Dines, in February; the average for March being slightly higher. So far as he understood the diagrams exhibited by Mr. Cory, they seemed to prove that rain and the spectroscope did not go closely together.

Mr. BREWIN stated that he had used a spectroscope for some months, and had taken it with him to the South of France and Italy, to test it in a clearer atmosphere than that of the neighbourhood of London, where he thought it would rarely be used under proper conditions, but as yet he had arrived at no satisfactory results.

The PRESIDENT (Mr. LAUGHTON) asked Mr. Cory how he distinguished changes in the shades of colours in the spectrum. It was not only exceedingly difficulty to remember shades of colour, with any exactness, but an apparent difference might often be due to the eye of the observer, which, under different conditions, was not always affected by even the same colour in the same way.

Mr. CORY, in reply, remarked that it was some time before he was able to fix a

scale for the estimation of the amount of rain-band. He had never seen the band quite black, nor had he ever seen it wholly absent. So far as his experience went he believed that the small spectroscopes were the best for observing the rain-band; that it was only by using the instrument in the way explained in the paper that any success could be attained. He had not found much difficulty about the shades of colour in the spectrum, the difference at times being most marked; for instance, when the blue was very deep blue, the F line could hardly be distinguished, and on the contrary when this colour was much lighter and clearer, this line would be very conspicuous.

Captain MACLEAR submitted the following remarks. He began to observe the atmospheric absorption bands in 1871, and during the passage to India of the Eclipse Expedition that year he watched the very great changes in those bands according to surroundings. For instance, on leaving England and in the Mediterranean, the length of the spectrum about sunrise extended generally from B in the red to near G in the violet, but it differed with the state of the sky. If the sun rose among yellow tinted clouds, or those "drawing water," the absorption bands from B to D, and particularly those near D, now called the "rain-band," were exceedingly well defined. At the same time the blue end did not extend so far as usual, showing there was greater absorption of the blue, while probably the greater quantity of aqueous vapour in the air reflected the red and yellow rays. A clear sunrise, on the contrary, showed an extension of the violet end, while the bands at B, C, and D were less defined, as if the red and yellow light were not enough to show them out by contrast. On passing through the Suez Canal and down the Red Sea the spectrum was shortened at both ends, which seemed to show a general absorption going on in the atmosphere, probably from light dust. The distant mountains were of a beautiful purple colour, as if, though the violet were absorbed, the red rays were so to a less degree, whilst the want of aqueous vapour allowed nearly all the yellow rays to be transmitted. In the Indian Ocean the blue became greatly reduced and the red end extended to A. The aqueous bands were very strong indeed—so much so on two mornings that D_1 and D_2 could hardly be distinguished amid the black mass that surrounded them. On the passage home the same results were obtained as on going out, and on regaining higher latitudes the blue end of the spectrum lengthened out and the bands beyond F, particularly about 2330K, became distinct. These observations were communicated to *Nature* in February, 1872, and for some months he continued to observe the bands morning and evening, in the hope of obtaining some exact method of forecasting weather; but he found that the effects were too local to be reduced to any method. The bands differed with the azimuth and with the altitude of the place pointed at, and with the time of day, as well as with the angular distance from the sun, and though he could manage a scale of intensity by comparison, it would only suit the spectroscope he was using, and was not comparable with any other, and he had to abandon the idea of employing the spectroscope as a meteorological instrument for the present. Undoubtedly, as shown by Mr. Capron, a yellow tint which denoted aqueous vapour showed the rain-band clearly by contrast; when rain began to fall the light was less and the rain-band was not so plain as before. The sign of the coming rain was in the yellow colour reflected from the sky, and this was easier detected in the spectroscope by contrast than with the naked eye. But there was nothing to show whether the suspended moisture was close to and low, or distant and high; a variety of subjects had to be taken into consideration. Mr. Cory said—point in the direction of the wind, or if one can foretell, in the probable direction as shown by the movements of the upper clouds—but this introduced another element of uncertainty. The spectroscope might be very useful to a skilled observer for his particular locality when taken with other prognostics, but he did not think at present that the results would be useful for any other station.

PROCEEDINGS AT THE MEETINGS OF THE SOCIETY.

MAY 16th, 1883.

Ordinary Meeting.

JOHN KNOX LAUGHTON, M.A., F.R.A.S., F.R.G.S., President, in the Chair.

FRANK ARTHUR BELLAMY, 44 Wellington Square, Oxford ;
THOMAS ANDREW MERCER, 28 High Street, Enniskillen ;
REV. HENRY JAMES POOLE, Stowell Rectory, Sherborne ; and
ALFRED T. TUCKER WISE, M.D., L.R.C.P., Kursaal de la Maloja, Haute Engadine, Switzerland ;
were balloted for and duly elected Fellows of the Society.

The following Papers were read, viz. :—

"COMPOSITE PORTRAITURE ADAPTED TO THE REDUCTION OF METEOROLOGICAL AND OTHER SIMILAR OBSERVATIONS." By G. M. WHIPPLE, B.Sc., F.R.Met.Soc., F.R.A.S. (p. 189.)

"NOTE ON ATMOSPHERIC PRESSURE DURING THE FALL OF RAIN." By H. SOWERBY WALLIS, F.R.Met.Soc. (p. 193.)

"METEOROLOGICAL OBSERVATIONS AT ZANZIBAR, EAST COAST OF AFRICA, DURING 1880-81." By SURGEON-MAJOR C. T. PETERS, M.B. (p. 196.)

"DIURNAL RAINFALL AT BANGKOK, SIAM." By Capt. G. H. INSKIP, F.R.G.S.

WHILST employed in the Survey of the Gulf of Siam in H.M.S. *Saracen*, the Author spent the months of September and October, two years following, in the City of Bangkok ; and as September is considered the wettest month in the year, he was curious to ascertain whether it rained more frequently at any particular period during the twenty-four hours, and drew out a form for the purpose, of which the following is an abstract :—

Number of times Rain fell, 1856-57.

Month.	Midt.	4 a.m.	8 a.m.	Noon.	4 p.m.	8 p.m.
September	19	17	9	2	13	13
October	12	8	1	5	6	15

These values show that rain fell more frequently by night than by day, and that the forenoon was the driest portion of the day.

Rain seldom fell continuously for any length of time, but generally in a heavy shower lasting for an hour or two.

"NEW METHOD OF READING A THERMOMETER AND A HYGROMETER AT A DISTANCE BY MEANS OF ELECTRICITY." By ARTHUR W. WATERS, F.G.S., F.Z.S. (p. 205.)

"AN INTEGRATING ANEMOMETER." By WILLIAM FORD STANLEY, F.R.Met.Soc. (p. 208.)

"OBSERVATIONS ON THE FORCE OF THE WIND AT SEA." By D. WILSON-BARKER, F.R.Met.Soc., R.N.

THE following paper gives a comparison of the force of wind as estimated on Beaufort's scale with the velocity of the same wind as recorded by two anemome-

ters; the one after Dr. Robinson's pattern modified for portability by Mr. Russell of Sydney, N.S.W.; and the other after that of M. Hagemann modified by Mr. Ellery, Government Astronomer at Melbourne. The latter compared both instruments with the standard in use at the Observatory before I took them away.

For the sake of brevity they will respectively be alluded to as the cup anemometer and the siphon anemometer. The observations were taken on board the sailing ship *Superb* during a voyage from Melbourne to London. Great care was taken to estimate rightly the force of the wind on Beaufort's scale, and although the instrumental records must be affected to some extent by the resistance of the hull and sails of the ship to the free course of the wind; still it is hoped that the comparison will not be without practical value.

The instrumental observations were all made by myself standing on and directly over the weather side of the stern, that being the part most likely to be clear of draughts, there being no sail near; and, the two instruments being used in succession, any difference in their results may be fairly imputed to differences in the instruments themselves.

On p. 58 of *Instructions in the use of Meteorological instruments*[1] is an estimate of the probable velocity of the wind represented by each degree of the Beaufort scale of forces. The result of the present discussion gives a lower velocity than that in the table for each of those forces which were experienced whilst the anemometers were being recorded. This may be partially accounted for by the interference of the ship's hull, &c., but I think (owing to the favourable position in which the observations were taken) that interference would be slight.

In the following table a comparison is made of a number of observations taken at the same time by both gauges in the same position, *i.e.* as already remarked over the stern of the ship, all corrections being applied :—

Velocity of Wind in miles per hour ..	0—5	6—10	11—15	16—20	21—25	26—30	31—35	36—40	41—45	46—50
Number of Observations ..	51	168	127	104	57	35	20	4	2	1
Excess of Cup over Siphon Readings	1·7	0·2	0·1	0·1	0·1	0·1	0·08	0·1	0·03	0·1

It will be seen that the cup gauge registered about 10 per cent. more miles per hour than the siphon. From my own experience I am strongly inclined to think that the siphon gauge registers the most correctly; it also has the advantages of being instantly read, very handy, and, if broken, easily refitted.

DISCUSSION.

Mr. MAWLEY remarked that if any one should be able to judge correctly the varying strength of the wind, it was an officer of a sailing ship whose attention was being so constantly directed to this point. He was however afraid now that steamers were so rapidly superseding sailing vessels that those who had acquired the peculiarly sensitive faculties necessary for a correct estimation of wind-force would become fewer and fewer every year. Meteorological observers on shore, however, quite unlike those at sea had this one weak point, namely, their general inability to gauge with accuracy the force of the wind at any one time, as was plainly shown by the great discrepancies in their records. For this reason he should much like to see some handy anemometer similar to those employed by Mr. Barker in the hands of all the Society's observers, as then something at all events approaching to comparable results might reasonably be looked for.

Mr. SCOTT said that when he made the table of comparison between the

[1] Compiled by direction of the Meteorological Council, by Robert H. Scott, M.A., F.R.S.

Beaufort scale and Robinson's anemometer, it was not known that the records of anemometers of different sizes did not agree, and in his opinion the difference between Mr. Barker's observations and the table referred to might be partly due to that cause. With respect to the accuracy with which seamen estimated wind force, he had recently compared the reports of wind taken by the lighthouse officials at Heligoland and those taken by good observers on steamers going in and out of the Elbe, and found that they rarely differed in their estimations.

Capt. MACLEAR considered it essential that officers of ships should have some means of judging the force of wind at sea, other than by the arbitrary Beaufort scale method. There was no young officer in the naval service who understood this scale as originally devised. In the *Challenger* Expedition an ordinary Robinson cup anemometer had been used, and was found to answer fairly well in the trade winds where the force and direction were steady; but when exposed in variable winds it was of but little use. He then remarked on the great difficulty experienced in making wind observations at sea, owing to the fact that allowance had to be made for the motion and rate of the ship, as well as the direction in which it was going.

Mr. C. HARDING remarked that on board ship was not a suitable situation for testing an anemometer against the Beaufort scale; a better way to do this would be to get an intelligent lighthouse-keeper to use an anemometer, and also to note the speed of passing sailing ships and the sail carried. The agreement between the two anemometers employed by Mr. Barker was very striking.

Mr. CORY stated that he had used Russell's anemometer on board ship, and had obtained very good results from it. He also mentioned that it was quite possible to hold this instrument up even in a strong gale of wind.

Mr. LADD remarked on the difficulty of observing the wind at sea, and said that the method he adopted in determining its direction was to watch the curl of the wavelets that were immediately influenced by it, the apparent force being augmented or diminished as a ship steamed towards or from its direction. The estimation of the real force was entirely a matter of practical experience, the scale used for expressing it, as Capt. Maclear remarked, being somewhat arbitrary.

The PRESIDENT (Mr. LAUGHTON) said that landsmen always seemed to suppose that the effect of a ship's way on the apparent direction of the wind was a new discovery, the peculiar property of themselves, instead of being, as it was, the very first thing, as to the wind, which a sailor learned to observe. He quite agreed with what Captain Maclear had said about the difficulty of anemometric observations on board ship: vague as the Beaufort scale might be, he thought it was less uncertain than any anemometer as yet recognised. His own fancy turned in the direction of Hagemann's anemometer, with a pipe leading up the mizen mast. He hoped the day would come when the constants of this instrument could be determined with sufficient exactness to give it a practical utility.

JUNE 20th, 1883.

JOHN KNOX LAUGHTON, M.A., F.R.A.S., F.R.G.S., President, in the Chair.

EMANUEL RISTORI, F.R.A.S., 13 Pembridge Crescent, Bayswater, W., was balloted for and duly elected a Fellow of the Society.

The following Papers were read, viz.:—

"ON THE STRUCTURE OF "CIRRO-FILUM," OR THE ICE-CLOUD DISPOSED IN THREADS." By the Rev. W. CLEMENT LEY, M.A., F.R.Met.Soc. (p. 210).

"NOTES ON A SECOND SERIES OF EXPERIMENTS ON THE DISTRIBUTION OF PRESSURE UPON FLAT SURFACES PERPENDICULARLY EXPOSED TO THE WIND." By RICHARD H. CURTIS, F.R.Met.Soc. (p. 221.)

"ON THE REDUCTION OF WIND RECORDS." By the Hon. RALPH ABERCROMBY, F.R.Met.Soc. (p. 226.)

"THE SPECTROSCOPE AS AN AID TO FORECASTING WEATHER." By FREDERIC W. CORY, M.R.C.S., F.R.Met.Soc. (p. 234.)

"NOTE ON RIVER TEMPERATURES AS COMPARED WITH AIR TEMPERATURES AT GREENWICH AND BREMEN." By ROBERT H. SCOTT, M.A., F.R.S., F.R.Met.Soc.

SIR G. B. AIRY has recently submitted to the Royal Society[1] a comparison between the records of the temperature of the Thames and those of air temperature taken at Greenwich, for a period of over thirty years. It has struck me that it might be of some interest to compare the results given in the paper above mentioned with those published in 1869 by Herr von Freeden, for the temperature of the Weser, as compared with that of the air at Elsfleth, close to Bremen, for the ten years 1858-67, which coincide with a portion of the period referred to by Sir G. B. Airy.

The two stations are not very dissimilarly situated, both observatories lying on the tidal portion of the respective rivers, but above the influence of any direct contact with the sea, as evidenced by the water being always fresh.

The main difference between the two series of air observations is, that while Greenwich Observatory is about 160 ft. above the level of the Thames, that at Elsfleth is not more than 20 ft. above the mean Weser level. The mode of exposure of the thermometers, in the two cases, is also not identical, but the difference arising from this latter cause may be neglected. The effect of the former is slightly to raise the Greenwich curve of differences throughout by reducing the air temperature.

TABLE I.—DIFFERENCE BETWEEN WATER AND AIR TEMPERATURES.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
Weser.													
1858—67	° 2·3	° 1·9	° 2·1	° 4·5	° 4·7	° 5·7	° 5·4	° 4·1	° 3·3	° 2·8	° 1·7	° 1·1	° 3·3
Thames.													
1858—67	0·7	0·5	0·4	1·2	1·2	2·0	2·1	1·8	2·1	2·4	2·3	1·1	1·5
1858—69	0·4	0·3	0·5	0·8	1·2	1·7	1·6	1·5	1·6	2·3	2·3	0·7	1·2
1845—56	0·5	0·6	1·1	2·0	2·5	2·8	2·2	2·3	2·2	1·4	1·8	0·4	1·7
1871—79	0·8	0·1	0·7	1·0	1·9	1·4	1·6	1·6	2·4	3·2	2·4	0·8	1·5
Whole Period ..	0·5	0·4	0·8	1·3	1·9	2·0	1·8	1·8	2·0	2·2	2·1	0·6	1·5

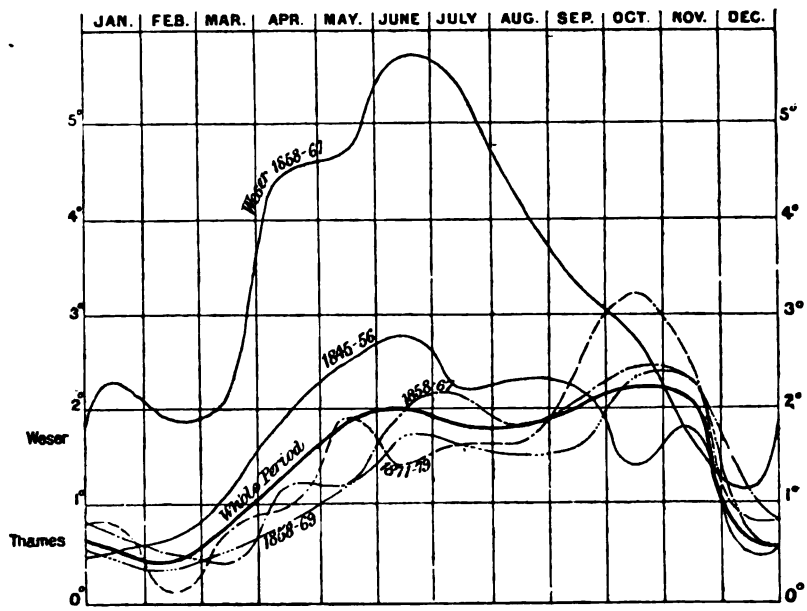
If the figures representing the monthly means of difference between air and water temperature be plotted on a diagram, it will be seen that on the monthly averages the temperature of the water is invariably above that of the air. In the cases of individual months the difference is in the opposite direction, but this is exceedingly rare at the German station. At Greenwich it is more frequent, and, in fact, in two years the mean difference was *nil*, the water in several months being colder than the air. On the whole, the differences for the Weser have a much greater range than those for the Thames, a circumstance naturally attributable to the greater range of temperature in central and northern Germany than in the Thames valley.

The most remarkable feature in the Weser curve is that the temperature of the river approaches much more nearly to that of the air in December than in any other month; the difference (1°·1) being not much more than one-half of that which obtains (1° 9) in February, the month standing next to December in point of agreement of the two temperatures. The maximum difference falls in June, and the curve has generally a fairly uniform rise and fall, with the exception of a relative maximum of difference in January as compared with the adjacent months, the reason of which is not obvious.

[1] *Proceedings*, Vol. xxxiv. p. 276.

Looking now at the Thames curves, firstly that for the ten years 1858-67, corresponding to those for the Weser, and then for the entire period : they will be seen on the whole to follow a more uniform course than that above described, reaching a maximum in the autumn, when the values for October and November are nearly identical, and a minimum in the winter. There is no trace of the secondary maximum in January which marks the Weser curve.

Fig. 1.



Difference between Water and Air Temperatures—Rivers Weser and Thames.

The Thames records fall into three groups, owing to interruptions in the continuity of the observations. They cover thirty-one years between 1844 and 1879, viz. 1845-56, 1858-69 and 1871-79, giving thus two intervals of twelve and one interval of nine years.

Curves representing these means projected for the three periods exhibit appreciable differences, and in particular the curve for 1858-69 lies, in every month except March, lower than that for the ten years 1858-67. This is attributable to the fact that for the two years 1868 and 1869 the mean temperature of the river exactly coincided with that of the air ; but it shows how variable a quantity the difference between the two temperatures is, when the results of two years alter the course of a ten years' curve so materially.

The same feature, of irregularity in the differences, comes prominently forward on examination of the curves for the periods 1845-56 and 1871-79. The former of these shows a maximum in June, and a local minimum in October, the month in which all the other Thames curves are at their highest value. The last mentioned curve, that for the nine years (1871-79), has a greater amplitude than any other Thames curve, the difference in February being only 0°·1, while in October it is 3°·2.

An examination of the annual march of the ordinary meteorological elements, to see if any of them exhibits features similar to those above described, of the difference between air and water temperatures, shows that such is the case with the rainfall, which reaches a maximum for Elsfleth in June and for Greenwich in October, the months respectively of maximum difference of air and water temperature. At first this would seem to be a satisfactory agreement, inasmuch as in the summer and autumn rainfall decidedly lowers the temperature of the

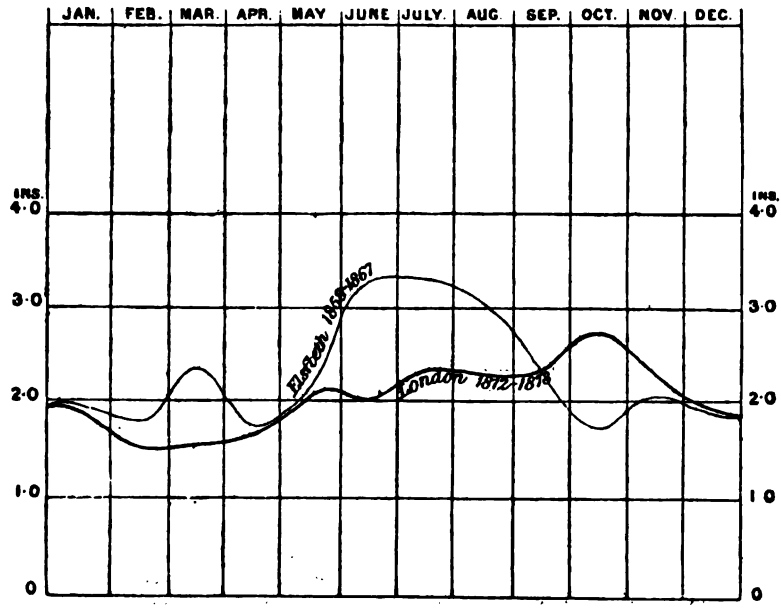
air, and therefore increases the difference between it and the comparatively constant temperature of the river.

TABLE II.—AVERAGE FALL OF RAIN.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
Elsfleth. 1858—67	In. 1·94	In. 1·80	In. 2·37	In. 1·75	In. 2·16	In. 3·29	In. 3·31	In. 3·08	In. 2·36	In. 1·71	In. 2·03	In. 1·87	In. 27·67
London. 1812—73	1·91	1·50	1·52	1·66	2·07	2·01	2·32	2·26	2·35	2·74	2·28	1·93	24·55

It must, however, be admitted that the anomalies in the course of the Thames curves for 1845-56 and 1871-79 are not accompanied by a corresponding modification of the course of the monthly rainfall for the respective periods.

FIG. 2.



Monthly Rainfall at Elsfleth and London.

As regards the peculiarity of the month of December at Elsfleth, which exhibits the greatest reduction of the difference between air and water temperatures, the only suggested explanation is that December was the cloudiest month in the year. In January frost set in with a clear sky, and the difference increased. In February the sky became more overcast, and the curves therefore approach each other.

RECENT PUBLICATIONS.

ANNALES DU BUREAU CENTRAL MÉTÉOROLOGIQUE DE FRANCE, PUBLIÉES PAR E. MASCART, Directeur du Bureau Central Météorologique. Année 1880. Part II. 4to. 1882.

The first part contains the results from second order stations in France and Algeria (266 pp.); while the second part is devoted to a monthly climatological review for France and the neighbouring countries during 1880 by M. A. Angot (50 pp.). This is accompanied by 40 plates showing for each month and the year, the distribution of pressure, wind, temperature, and rainfall.

ANNALI DELL'UFFICIO CENTRALE DI METEOROLOGIA ITALIANA. Serie II. Vol. III. Parts I., II. and III. 1881. 4to. 1882-8.

Part I. contains:—Sulla distribuzione della pioggia in Italia. Memoria del Prof. E. Millosevitch (145 pp. and 25 plates).—Sulle ore delle massime e minime velocità assolute del vento in Modena, del Prof. D. Ragona (3 pp.).—Sul periodo diurno della elettricità atmosferica e della corrente tellurica ascendente, del Prof. D. Ragona (8 pp.).—Il barometro normale dell'Ufficio Centrale della Meteorologia Italiana, del Prof. C. Chistoni (20 pp.).—Osservazioni dei temporali raccolte nel 1880 e relativo studio del Dr. C. Ferrari (256 pp. and 40 plates). Part II (747 pp.) is devoted to the meteorological observations made in Italy during 1881, the results of which have been compiled under the direction of Prof. P. Busin. Part III. contains: Meteorologia Solare 1881, del P. Tacchini (49 pp.).—Osservazioni Meteorologiche fatte nel R. Osservatorio del Collegio Romano e Reviste mensili del 1881. (100 pp.).

ANNUAIRE DE LA SOCIÉTÉ MÉTÉOROLOGIQUE DE FRANCE. 1882, Juillet-Octobre; 1883, Mars-Mai. Royal 8vo. 1883.

Contains:—Résumé des observations centralisées par le Service hydrométrique du bassin de la Seine, pendant l'année 1881, par M. de Préaudeau (29 pp.).—Aurores boréales observées pendant l'hivernage de "la Vega," par A. E. Nordenskiœld (7 pp.).—Note sur le phénomène de l'arc-en-ciel double, par C. Ritter (4 pp.).—Sur la création projetée d'une mer Intérieure en Algérie, par E. Renou (7 pp.).—Sur les résultats climatériques probable de la submersion des Chotts Tunisiens, par C. Ritter (13 pp. and plate).—Etude sur l'hiver de 1879-80 et recherches sur l'influence de la position des grands centres d'action de l'atmosphère dans les hivers anormaux, par L. Teisserenc de Bort (9 pp.).—Manuel de la prévision du temps à Bar-le-Duc, par M. Poincaré (36 pp.).—Influence de l'altitude sur les phénomènes de la végétation, par A. Angot (2 pp.).—Contribution à l'étude du climat de l'Afrique Centrale, par A. Angot (5 pp.).—Sur la réduction du baromètre au niveau de la mer, par L. Teisserenc de Bort (7 pp.).

ANNUAL REPORT OF THE BOARD OF REGENTS OF THE SMITHSONIAN INSTITUTION, showing the Operations, Expenditures, and Condition of the Institution for the Year 1881.

The General Appendix contains a record of recent scientific progress. The record of Meteorology and allied subjects (101 pp.) has been compiled by Prof. Cleveland Abbe, and embraces the period 1879-81. It consists almost exclusively of abstracts from *Nature* and the *Zeitschrift für Meteorologie*.

ANTIQVARISK TIDSKRIFT FÖR SVERIGE. Del 7. No. 2. 8vo. 1883.

Contains:—Samling af bemarkelsedagar, tecken, märken, ordspråk och skrock rörande väderleken, af H. H. Hildebrandsson (118 pp.). This is a collection of popular sayings, superstitions, &c. concerning the weather, referring mostly to Sweden.

BULLETINS DE L'ACADÉMIE ROYALE DES SCIENCES, DES LETTRES ET DES BEAUX-ARTS DE BELGIQUE. 3 me Serie. Tome IV.-V. 1882-83.

Tome IV. contains:—Sur le siége des orages et leur origine, par W. Spring (23 pp.).—Note sur l'Aurore boréale du 2 Octobre 1882, par Dr. F. Terby (10

pp.).—Notice sur une particularité de l'aurore boréale du 2 Octobre 1882, et sur l'accroissement d'intensité de la scintillation des étoiles pendant les aurores boréales, par C. Montigny (20 pp.).

CIEL ET TERRE. REVUE POPULAIRE D'ASTRONOMIE DE MÉTÉOROLOGIE, ET DE PHYSIQUE DU GLOBE. Quatrième Année. Nos. 11-16. Août-Octobre 1883. 8vo.

The principal meteorological contents are :—La nature du vent, par J. C. Houzeau (3 pp.).—Recherches sur la période lunaire des aurores boréales, par Dr. F. Terby (12 pp.).—Retour des oiseaux d'été en 1883, par J. Vincent (4 pp.).

KONGLIGA SVENSKA VETENSKAPS AKADEMIENS HANDLINGAR. Band 8, No. 7. 8vo. 1883.

Contains :—Sur la variation diurne de la force du vent, par Dr. H. E. Hamberg (48 pp. and plate).

NOVA ACTA REGIÆ SOCIETATIS SCIENTIARUM UPSALIENSIS. Ser. III. 1883. 4to.

Contains :—Sur la trombe du 7 Juin, 1882, dans la Vallée de Säby, par C. G. Fineman (35 pp. and 7 plates). —Sur la distribution des éléments météorologiques autour des minima et des maxima barométriques, par H. H. Hildebrandsson (31 pp.).

OFVERSIGT AF KONGL. VETENSKAPS-AKADEMIENS FÖRHANDLINGAR. 1882. No. 1. 8vo.

Contains :—Orn isförhällandena i Sveriges rinnande vatten, af E. Solander (10 pp. and chart).

PROCEEDINGS OF THE MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY. Vol. XXII. 8vo. 1883.

Contains a paper by Mr. A. W. Waters, entitled " Observations made in St. Moritz in the Winter 1882-83." St. Moritz, a village in the Engadine, is 6,089 ft. above the sea.

PROCEEDINGS OF THE ROYAL SOCIETY. Vol. XXXV. No. 226. 8vo. 1883.

Contains :—Note on the establishment and first results of simultaneous thermometric and hygrometric observations at 4 and 170 ft., and of Siemens' electrical thermometer at 260 ft. above the ground, by G. J. Symons, F.R.S. (10 pp.).—The influence of water in the atmosphere on the solar spectrum and solar temperature, by Capt. Abney, R.E., F.R.S., and Col. Festing, R.E. (13 pp.).

REGENWAARNEMINGEN IN NEDERLANDSCH-INDIË. Vierde Jaargang. 1882. Door Dr. J. P. VAN DER STOK, Directeur van het Observatorium te Batavia. 8vo. 1883. 341 pp.

This is the fourth yearly report on the Rainfall in the East Indian Archipelago, and contains observations from 143 stations. In addition to the usual abstracts, the rainfall at each station is given according to periods corresponding with the eight different phases of the moon. The results show that in West Java and Sumatra there is an excess of rain on days of new moon, while in the other districts there is, on the whole, a maximum rainfall on days of full moon.

REPORT OF THE SCIENTIFIC RESULTS OF THE VOYAGE OF H.M.S. CHALLENGER DURING THE YEARS 1873-76, under the command of Captain George S. Nares, R.N., F.R.S., and Captain Frank T. Thomson, R.N. Prepared under the superintendence of the late Sir C. WYVILLE THOMSON, Knt., F.R.S., and now of JOHN MURRAY, F.R.S.E. Narrative; Vol. II. 4to. 1882. 824 pp.

The meteorological observations taken on board H.M.S. Challenger are given in detail, and extend from December 1st, 1872, to May 27th, 1876. The observations were uniformly made at two-hourly intervals by the officer of the watch, excepting at the hours of 6 a.m. and 6 p.m., when the instruments were recorded by the Staff-Commander. From December 21st, 1873, to March 17th, 1874, the

ship being in the Southern part of the Indian Ocean, and for some days in the immediate neighbourhood of the Antarctic Circle, hourly observations were made. In the Appendix there is a Report on the Pressure Errors of the Challenger Thermometers, by Prof. Tait (42 pp.).

SITZUNGSBERICHTE DER KAISERLICHEN AKADEMIE DER WISSENSCHAFTEN. Band LXXXVIII. II. Abth. Juni-Heft. 1883. 8vo.

Contains:—Ueber die klimatischen Verhältnisse von Bosnien und der Herzegowina, von Dr. J. Hann (21 pp.).

STATISTICS OF LANCASTER RAINFALL AND OTHER LOCAL METEOROLOGICAL INFORMATION. Compiled by WILLIAM ROPER, F.M.S. 8vo. 1883.

This contains tables of monthly rainfall at Lancaster from 1784 to 1793, 1800 to 1817, 1848 to 1851, and 1867 to 1882; mean temperature of the air in each month at 2 p.m. and 10 p.m. from 1784 to 1790; summary of two years' daily observations of the direction of the wind, 1818-19; and monthly results of meteorological observations made by Mr. Roper from April, 1881, to September, 1883.

SUPPLEMENT TO THE JAMAICA GAZETTE. New Series. Vol. VI. No. 14. Folio, 1883.

This contains an article by Mr. Maxwell Hall on the Rainfall of Jamaica from 1870 to 1879. Tables are given showing the mean monthly rainfall for the 10 years at 61 places. Taking the general results October is the wettest month, 10·07 ins., and February the driest month, 2·38 ins.; the total for the year is 67·41 ins.

SUSSEX NATURAL HISTORY, FOLK-LORE AND SUPERSTITIONS. By FREDERICK ERNEST SAWYER, F.M.S. 8vo. 1883. 16 pp.

This is a paper read before the Brighton and Sussex Natural History Society on June 14th, 1883. The sayings are grouped under the following heads:—Astronomical, Animal, Bird, Reptile, Mollusc, Insect, Fish, Plant, and Meteorological.

SYMONS'S MONTHLY METEOROLOGICAL MAGAZINE. Vol. XVIII. Nos. 211-218. August-October, 1883. 8vo.

The principal articles are:—Meteorological Bibliography (4 pp.).—Temperature Observations at Boston, Lincolnshire (4 pp.).—On Lightning figures, by C. Tomlinson (3 pp.).—Atmospheric Vapour Meter, by W. H. Dines (2 pp.).—On Simultaneous Temperatures at Different Heights, by C. Tomlinson (2 pp.).—On the Climate of the British Empire during 1882 (2 pp.).—The British Association at Southport (with abstracts of some of the meteorological papers) (8 pp.).

THE FIFTIETH AND JUBILEE REPORT OF THE ROYAL CORNWALL POLYTECHNIC SOCIETY. 1882. 8vo. 1883. 388 pp.

In connection with the Jubilee Meeting, which was held at Falmouth from September 5th to 16th, 1882, there were lectures and conferences, and also an exhibition of instruments and works of art. The meteorological papers are: On Rainfall Observations in Cornwall, by G. J. Symons, F.R.S., (5 pp. and map); The Royal Cornwall Polytechnic Society, and its Promotion of Meteorology, by W. L. Fox (8 pp.); and Meteorology, or Weather Knowledge: its Progress and Modern Aspects, by G. M. Whipple (7 pp.). The Appendix contains Tables of Sea Temperature, bright sunshine, and climate at Falmouth for the year 1882, and notes by W. L. Fox, with other meteorological tables for West Cornwall and the Scilly Islands.

THE FOLK-LORE JOURNAL. Vol. I. Part VII. July, 1883. 8vo.

Contains a paper by Mr. F. E. Sawyer entitled "S. Swithin and Rainmakers," (6 pp.).

TRANSACTIONS AND PROCEEDINGS OF THE ROYAL SOCIETY OF VICTORIA. Vol. XIX. 8vo. 1883.

Contains:—Quantity of Water consumed in Irrigation, by W. W. Culcheth

(24 pp.).—Floods on the River Barwon, by W. C. Kernot (4 pp.).—Notes on the Storms of high South Latitudes, by D. W. Barker (5 pp. and plate.)

WEATHER SAYINGS, PROVERBS, AND PROGNOSTICS, CHIEFLY FROM NORTH LANCASHIRE. 8vo. 1888. 84 pp.

This collection of weather proverbs and sayings has been compiled by Mr. W. Roper, of Lancaster. The proverbs, which have been mostly collected from Lancaster and its neighbourhood, are arranged under the following headings:—The Sun, Moon, Wind, Rainbow, Clouds, Plants, Seasons, Months, Days of the Week Places, Wet and Dry, Audibility, Animals, Birds, Insects, &c., Fish, General, The Barometer, and Weather Predictors.

ZEITSCHRIFT DER ÖSTERREICHISCHEN GESELLSCHAFT FÜR METEOROLOGIE. Redigirt von Dr. J. HANN. XVIII Band. August-October, 1888. 8vo.

Contains:—Ueber die Vertheilung des Luftdruckes und der Temperatur während grösserer Gewitter, von W. v. Bezold (6 pp. and plate).—Das Klima der britischen Inseln, von A. Buchan (4 pp. and plate.).—Ueber den täglichen und jährlichen Gang des Luftdruckes auf Berggipfeln und in Gebirgsthälern, von J. M. Pertner (5pp.).—Ueber das Polarlicht, von Prof. H. Fritz (14 pp.).—Ueber die Zulässigkeit der Verwendung von Luftthermometern in der Meteorologie, von Dr. Maurer (5 pp.).—Ueber eine einfache Art, Thermometer zur Beobachtung von Temperaturen in Brunnen, Flüssen oder Seen geringerer Tiefe zu montiren, von Dr. C. Lang (5 pp.).—Zum Klima des äquatorialen Innerafrika (6 pp.).

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THE END.

METEOROLOGY OF ENGLAND,

DURING THE QUARTER ENDING DECEMBER 31, 1882.

REMARKS ON THE WEATHER DURING THE QUARTER ENDING DECEMBER 31ST, 1882.

By JAMES GLAISHER, Esq., F.R.S., *&c.*

The first half of the month of October was warm, and the second half cold. The atmospheric pressure was above its average for the first 10 days, and below it afterwards. The month was wet and unsettled. Rain fell at most stations in the Southern and Midland counties to more than double the average, lowlands were flooded; there was a gale of wind on the 24th, with snow at many places; the fall of rain on this day was heavy and exceeded one inch in depth at several stations.

The month of November was warm during the first 10 days, cold from the 11th to the 21st, then warm and cold alternately. The atmospheric pressure was low throughout the month. Rain fell everywhere in excess of the average; the month was unsettled and changeable, and farm work almost at a standstill owing to the wetness of the land.

December. Till the 15th day the weather was foggy and very cold, at times severely so, snow falling frequently; it was warm from the 16th to the end of the month, remarkably so from the 26th. The atmospheric pressure was almost continuously below the average. The fall of rain was in excess of the average; the month was unsettled, with very little sunshine.

About London till the 15th of October the average daily excess of mean temperature was 2°·3; the weather was cold from the 16th to the 30th, the mean daily defect being 1°·3. The 11 days to November 10th were warm, being in excess of their average temperature by 3°·9 daily; this was followed by a like period of 11 days of cold, the average daily deficiency of mean temperature being 3°·8 daily; there were then 5 days of warm weather, the daily excess being 5°·5; then for 19 days, from November 27th to December 15th the weather was cold, particularly on the 11th and 12th of December, on which days it was 13°·9 and 13°·3 below the average; the mean daily deficiency for these 19 days was 5°·6. From this time to the end of the year it was warm, and particularly so from December 26th; on December 27th the excess was 15°·7, and on the 28th it was 15°·2, and the excess for the 6 days was 13¾°, and for the 16 days ending December 31st it was 6° 8.

The mean temperature of the air for October was 50°·8, being 1°·3 and 0°·8 above the average of 111 years and 41 years respectively; it was 5°·5 and 4°·6 higher than in 1881 and 1880 respectively.

The mean temperature of the air for November was 43°·5, being 1°·2 above the average of 111 years and the same as the average of 41 years; it was 5°·2 lower than in 1881, and 1°·0 higher than in 1880.

The mean temperature of the air for December was 40°·1, being 1°·0 and 0°·2 above the averages of 111 years and 41 years respectively; it was 0°·3 higher than in 1881 and 3°·1 lower than in 1880.

The mean temperature for the quarter was 44°·8, being 1°·2 above the average of 111 years and 0°·3 above the average of 41 years.

The mean high day temperature of the air in October was 57°·7, being 0°·4 below the average of 41 years; in November it was 48°·7, being 0°·2 lower than the average, and in December was 44°·0, being 0°·7 lower than the average. Therefore the high day temperature was low throughout the quarter.

The mean low night temperature of the air in October was 44°·7, being 1°·3 above average of 41 years; in November it was 38°·4, being 1°·1 above the average, and in December was 35°·6, being 0°·4 above the average throughout the quarter. Therefore the low night temperature was high throughout the quarter.

The mean daily range of temperature in October was 1°·8 smaller than the average, and in November was 1°·2 below the average, and in December it was 1°·0 below the average.

The mean temperature of the air in October was 3°·5 lower than in September, in November was 7°·3 lower than in October, and in December was 3°·4 lower than in November. (From the preceding 41 years observations the decrease of temperature from September to October is 7°·1; from October to November is 6°·5, and from November to December is 3°·6.)

From September to October, at stations south of latitude 51°, there was a decrease of 3° of temperature; and north of 51°, a decrease of 4°; from October to November, at stations south of 51°, there was a decrease of 5°·8, between 51° and 52° a decrease of 6·9, between 52° and 53° a decrease of 7°·6, between 53° and 54° a decrease of 7°·8, and north of 54° a decrease of 8°·9; from November to December, at stations south of 51°, there was a decrease of 2°·7, gradually increasing in amount to 4°·3 at stations north of 54°.

About London the mean daily pressure of the atmosphere till October 10th was above the average by 0·29 in.; and, from October 11th to the end of the year, it was below the average by 0·33 in.

The mean reading of the barometer for the month of October at the height of 159 feet above the sea was 29·656 ins., it being 0·053 in. below the average of 41 years; and 0·171 in. below that of 1881; and 0·049 in. below that of 1880.

The mean reading for November was 29·532 ins., being 0·217 in. below the average of 41 years, and 0·253 in. below that of 1881, and 0·261 in. below that of 1880.

The mean reading for December was 29·493 ins. being 0·302 in. below the average of 41 years, and 0·328 in. below that of 1881, and 0·256 in. below that of 1880.

The atmospheric pressure in October was 0·031 in. below that in September; that in November was 0·124 in. below that in October, and that in December was 0·039 in. below that in November.

(From the preceding 41 years observations the mean pressure in October is 0·095 in. below that in September; that in November 0·040 in. above that in October, and that in December 0·046 in. above that in November.)

From September to October there was a decrease of pressure at all stations of 0·054 in. at those south of 51°; of 0·038 in. between 51° and 52°; and of 0·020 in. at stations north of 52°; from October to November there was a decrease of 0·041 in. at southern stations, increasing gradually to 0·230 in. at northern stations; from November to December there was a decrease of 0·087 in. at stations south of 51°; of 0·049 in. at those between 51° and 52°; of 0·023 in. at those between 53° and 54°; between 53° and 54°, the readings in December were nearly the same as those in November; and north of 54° the readings in December were higher by 0·029 in. than in November.

1882. Months.	Temperature of Air. Mean.	Temperature of Air. Diff. from average of 111 years.	Temperature of Air. Diff. from average of 41 years.	Evaporation. Mean.	Evaporation. Diff. from average of 41 years.	Dew Point. Mean.	Dew Point. Diff. from average of 41 years.	Air—Daily Range. Mean.	Air—Daily Range. Diff. from average of 41 years.	Elastic Force of Vapour. Mean.	Elastic Force of Vapour. Diff. from average of 41 years.	Weight of Vapour in a Cubic Foot of Air. Mean.	Weight of Vapour in a Cubic Foot of Air. Diff. from average of 41 years.
	°	°	°	°	°	°	°	°	°	in.	in.	grs.	gr.
Oct. -	50·8	+1·3	+0·8	49·2	+1·2	47·5	+1·6	12·9	−1·8	·330	+0·019	3·8	+0·1
Nov. -	43·5	+1·2	0·0	41·2	−0·1	38·6	−0·8	10·3	−1·2	·234	−0·012	2·7	−0·1
Dec. -	40·1	+1·0	+0·2	39·0	+0·3	37·6	+1·0	8·4	−1·0	·225	+0·006	2·6	0·0
Means -	44·8	+1·2	+0·3	43·1	+0·5	41·2	+0·5	10·5	−1·3	·263	+0·004	3·0	0·0

1882. Months.	Degree of Humidity. Mean.	Degree of Humidity. Diff. from average of 41 years.	Reading of Barometer. Mean.	Reading of Barometer. Diff. from average of 41 years.	Weight of a Cubic Foot of Air. Mean.	Weight of a Cubic Foot of Air. Diff. from average of 41 years.	Rain. Amount.	Rain. Diff. from average of 66 years.	Daily Horizontal movement of the Air.	Reading of Thermometer on Grass. Number of Nights it was At or below 30°.	Between 30° and 40°.	Above 40°.	Lowest Reading at Night.	Highest Reading at Night.
			in.	in.	grs.	grs.	in.	in.	Miles.				°	°
Oct. -	88	+ 2	29·656	−0·053	538	− 2	5·43	+2·62	269	3	14	14	27·0	54·2
Nov. -	86	− 2	30·532	−0·217	544	− 4	2·19	−0·15	449	18	10	7	18·2	47·1
Dec. -	91	+ 3	29·498	−0·302	547	− 5	1·78	−0·22	288	14	10	7	20·3	48·1
Means -	88	+ 1	29·560	−0·191	543	− 4	Sum 9·39	Sum +2·25	Mean 335	Sum 30	Sum 34	Sum 28	Lowest 18·2	Highest 54·2

NOTE.—In reading this table it will be borne in mind that the plus sign (+) signifies *above* the average, and that the minus sign (−) signifies *below* the average.

The average duration of the different directions of the wind referred to eight points of the compass, and the duration of each direction in each month in the quarter, were as follow:—

Direction of Wind.	October. 1882.	October. Average.	October. Departure from Average.	November. 1882.	November. Average.	November. Departure from Average.	December. 1882.	December. Average.	December. Departure from Average.
	d.	d.	d.	d.	d.	d.	d.	d.	d.
N.W.	1½	2½	−1	5½	2½	+ 3	4	2½	+1½
N.	2½	3½	−1	1½	4½	− 2½	1½	3	−1½
N.E.	2½	3	− ½	1	4	− 3	1½	2½	−1
E.	6	1½	+4½	1½	2½	− ½	3½	2	+1½
S.E.	2½	2	+ ½	½	2	− 1½	4½	2	+2½
S.	4	4	0	½	4	− 3½	3½	3½	0
S.W.	7½	10	−2½	5½	8½	− 2½	8	11	−3
W.	5½	4½	+ ½	13½	2½	+10½	4½	4½	0

The plus sign (+) denotes excesses over averages; the largest numbers affected with this sign in the month of October are opposite to E. and W.; in November to W. and N.W.; and December to S.E., E., and N.W.

The minus sign (−) denotes deficiencies below averages. In October the largest numbers are opposite to S.W., N.W. and N.; in November to S. and N.E.; and in December to S.W. and N.

Thunderstorms occurred in October on the 2nd at Silloth; on the 8th at Torquay, Royston, Cambridge, and Halifax; and on the 24th at Llandudno, and Salisbury.

In November on the 2nd at Silloth; on the 4th at Stonyhurst; on the 7th at Silloth; on the 8th at Burslem, Wolverhampton, Halifax, Stonyhurst, Bradford, and Silloth; on the 9th at Bradford; on the 16th at Torquay; on the 19th at Guernsey; on the 25th at Bolton; on the 26th at Halifax; and on the 27th at Wolverhampton; and none in December.

Thunder was heard but lightning was not seen in October on the 8th at Salisbury and Hull.

In November on the 3rd and 4th at Carlisle; and on the 9th at Rugby.

Lightning was seen but thunder was not heard in October on the 7th at Osborne, Salisbury, Barnet, Oxford, Royston, and Cambridge; on the 8th at Torquay, Barnet, Oxford, and Lowestoft; on the 10th at Guernsey and Cambridge; on the 13th at Royston; on the 22nd at Guernsey, Bolton, Llandudno, and Stonyhurst; and on the 23rd at Bolton.

In November, on the 2nd and 4th at Carlisle; on the 5th at Halifax and Stonyhurst; on the 6th at Carlisle; on the 7th at Oxford and Carlisle; on the 8th at Plymouth, Strathfield Turgiss, Blackheath, Barnet, Oxford, Cambridge, Hull, and Carlisle; on the 9th at Plymouth, Torquay, and Hull; on the 10th at Hull; on the 12th at Stonyhurst; on the 19th at Plymouth; on the 20th at Guernsey and Plymouth; on the 25th at Halifax.

Aurora borealis was seen on the 1st October at Halifax; on the 2nd at Guernsey, Torquay, Oxford Barnet, Royston, Somerleyton, Cambridge, Leicester, Hull, and Silloth; on the 3rd at Oxford, and Hull; and on the 5th at Stonyhurst and Silloth.

In November on the 1st at Oxford; on the 12th at Stonyhurst and Silloth; on the 13th at Bolton and Stonyhurst; on the 14th at Stonyhurst; on the 17th at Guernsey, Totnes, Torquay, Osborne, Salisbury, Whitchurch, Blackheath, Oxford, Barnet, Royston, Somerleyton, Lowestoft, Cambridge, Halifax, Hull, Stonyhurst, and Silloth; on the 18th at Torquay and Cardington; on the 19th and 20th at Oxford.

In December on the 19th at Oxford; and on the 23rd at Halifax.

Solar halos were seen in October, on the 9th at Torquay and Oxford; and on the 29th at Oxford.

In November on the 2nd at Oxford; on the 3rd and 6th at Halifax; on the 7th at Halifax and Torquay; on the 11th and 16th at Torquay; on the 17th at Oxford; on the 21st at Torquay, Strathfield Turgiss, Oxford, Halifax, and Stonyhurst; on the 25th at Oxford; on the 27th at Torquay; and on the 28th at Halifax, Stonyhurst, and Silloth.

In December on the 1st at Oxford; on the 11th at Torquay; on the 20th at Halifax; and on the 23rd at Torquay.

Lunar halos were seen in October on the 20th at Wolverhampton; on the 23rd at Torquay; on the 24th at Cambridge, Burslem, and Silloth; on the 25th at Bolton and Halifax; on the 29th at Plymouth and Torquay; on the 31st at Oxford.

In November on the 2nd at Oxford; on the 17th at Torquay; on the 19th at Cambridge; on the 20th at Oxford, Lowestoft, and Stonyhurst; on the 21st at Oxford, Lowestoft, and Cambridge; on the 23rd at Halifax; on the 24th at Oxford; and on the 25th at Torquay.

In December on the 16th at Torquay; on the 17th, 19th, and 20th at Oxford; on the 20th at Halifax; on the 21st at Torquay; on the 22nd at Lowestoft and Cambridge; on the 23rd at Torquay, Oxford, Cambridge, and Halifax; and on the 24th at Barnet, Oxford, Lowestoft, and Cambridge.

Snow fell in October on the 16th at Hull; and on the 20th at Salisbury, Oxford, Royston, Cambridge, and Leicester.

In November, on the 8th at Burslem; on the 10th and 11th at Carlisle; on the 15th at Strathfield Turgiss, and Bolton; on the 16th at Osborne, Salisbury, Whitchurch, Blackheath, Barnet, Oxford, Royston, Cardington, and Carlisle; on the 17th at Royston and Lowestoft; on the 18th at Hull; on the 19th at Bolton, Halifax, and Carlisle; on the 20th at Burslem, Cambridge, Bolton, and Halifax; on the 24th at Halifax; on the 25th at Halifax and Bradford; on the 26th at Halifax; on the 27th at Burslem, Halifax, and Bradford; on the 30th at Cambridge.

In December, on the 2nd at Wolverhampton, Oxford, Burslem, Bolton, and Stonyhurst; on the 4th at Burslem, Wolverhampton, Bolton, and Halifax; on the 5th at Torquay, Barnet, Burslem, Cardington, Cambridge, Wolverhampton, Bolton, Llandudno, Halifax, Bradford, Silloth, and Carlisle; on the 6th at Guernsey, Torquay, Salisbury, Bath, Barnet, Oxford, Burslem, Cardington, Cambridge, Wolverhampton, Bolton, Llandudno, Halifax, Stonyhurst, and Bradford; on the 7th at Guernsey, Plymouth, Torquay, Osborne, Salisbury, Bath, Barnet, Oxford, Cardington, Lowestoft, Cambridge, Wolverhampton, Bradford, and Silloth; on the 8th at Plymouth, Torquay, Bath, Oxford, Burslem, Lowestoft, Cambridge, Wolverhampton, Bolton, Halifax, Bradford, and Silloth; on the 9th at Guernsey, Halifax, and Bradford; on the 11th at Carlisle; on the 12th at Torquay, Bath, Oxford, Burslem, Wolverhampton, and Bolton; on the 13th at Bath, Barnet, Cambridge, Bolton, Llandudno, Halifax, Stonyhurst, and Bradford; on the 14th at Llandudno, and Bradford; on the 23rd at Burslem; on the 25th and 26th at Silloth; and on the 30th at Burslem, Bolton, and Halifax.

Hail fell in October on the 7th at Osborne; on the 21st at Truro; on the 22nd at Truro, Totnes, Lowestoft, and Bolton; on the 23rd at Guernsey, Truro, and Silloth; on the 24th at Truro, Torquay, Salisbury, Oxford, Royston, Lowestoft, and Cambridge; and on the 25th at Guernsey, Truro, and Torquay.

In November on the 3rd at Halifax; on the 6th at Totnes; on the 7th at Totnes, Strathfield Turgiss, Wolverhampton, and Silloth; on the 8th at Truro, Totnes, Burslem, Llandudno, and Silloth; on the 9th at Guernsey, Truro, Burslem, and Llandudno; on the 10th at Truro, Llandudno, and Halifax; on the 11th at Guernsey and Llandudno; on the 14th at Guernsey; on the 15th at Guernsey and Truro; on the 16th at Truro; on the 17th at Truro, Lowestoft, and Hull; on the 19th at Guernsey, Oxford, Bolton, Llandudno, Stonyhurst, and Carlisle; on the 20th at Guernsey; on the 24th at Burslem, Bolton, Halifax, and Carlisle; on the 25th at Bolton, Llandudno, and Carlisle; on the 26th at Halifax and Stonyhurst; on the 27th at Guernsey, Truro, Burslem, Wolverhampton, Llandudno, Stonyhurst, and Carlisle; on the 28th at Guernsey, and on the 29th at Guernsey, Truro, and Whitchurch.

MONTHLY METEOROLOGICAL TABLE FOR THE QUARTER ENDING DECEMBER 31ST, 1882.

The Observations have been reduced to Mean values by Glaisher's Barometrical and Diurnal Range Tables, and the Hygrometrical results have been deduced from the sixth edition of his Hygrometrical Tables.

Names of Stations and Observers.	Height of Station above Sea Level.	Year 1882. Months.	Pressure of Atmosphere in Month. Mean.	Pressure of Atmosphere in Month. Range.	Temperature of Air in Month. Highest.	Temperature of Air in Month. Lowest.	Temperature of Air in Month. Range.	Temperature of Air in Month. Mean. Of all Highest.	Temperature of Air in Month. Mean. Of all Lowest.	Temperature of Air in Month. Mean. Daily Range.	Mean Temperature. Air.	Mean Temperature. Dew Point.	Vapour. Elastic Force.	Vapour. In a cubic foot of Air. Mean.	Vapour. In a cubic foot of Air. Short of Saturation.	Mean Degree of Humidity. Satn. = 100.	Mean Weight of a cubic foot of Air.	Mean Reading of Thermometer. Maximum in Rays of Sun.	Mean Reading of Thermometer. Minimum on Grass.	Wind. Estimated Strength.	Wind. Relative Proportion of N.	Wind. Relative Proportion of E.	Wind. Relative Proportion of S.	Wind. Relative Proportion of W.	Mean Amount of Ozone.	Mean Amount of Cloud.	Rain. Number of Days it fell.	Rain. Amount collected.
	feet.		in.	in.	°	°	°	°	°	°	°	°	in.	grs.	gr.		grs.	°	°									
GUERNSEY, Adolphus Collenette, Esq., F.M.S.	270	Oct.	29·544	1·417	66·3	40·3	26·0	58·1	48·9	9·2	53·2	48·8	·344	3·9	0·7	85	533	95·6	45·4	1·1	5	7	9	10	4·2	7·1	25	7·20
		Nov.	29·525	1·010	58·7	33·3	25·4	52·2	44·7	7·5	47·9	42·8	·276	3·1	0·7	83	539	79·9	40·7	1·5	8	1	5	16	4·9	7·5	30	7·95
		Dec.	29·422	1·225	54·6	30·0	24·6	47·6	41·0	6·6	44·5	42·5	·263	3·2	0·8	93	540	63·7	37·3	1·0	8	3	15	10	4·5	8·6	30	6·50
TRURO (Cornwall), C. Barham, Esq., M.D., F.M.S.	43	Oct.	29·739	1·247	66·0	30·0	36·0	59·3	46·9	12·4	52·0	48·2	·338	3·8	0·6	87	538	—	—	2·5	7	5	7	12	—	7·5	23	6·04
		Nov.	29·730	0·934	59·0	29·0	30·0	52·0	42·8	9·2	46·8	42·1	·268	3·2	0·6	84	544	—	—	3·0	7	3	5	15	—	7·3	28	5·57
		Dec.	29·622	1·134	56·0	22·0	34·0	49·5	39·7	9·8	44·5	41·2	·259	3·0	0·3	91	541	—	—	2·3	8	5	10	8	—	8·2	28	6·73
PLYMOUTH (Devon), J. Merrifield, Esq., LL.D., F.R.A.S., F.M.S.	69	Oct.	29·749	1·377	64·9	36·0	28·9	57·4	45·4	12·0	51·1	47·6	·332	3·7	0·5	88	539	—	—	1·4	7	9	6	9	—	7·9	22	5·86
		Nov.	29·729	0·941	60·0	29·0	31·0	51·3	40·8	10·5	45·7	41·6	·265	3·0	0·5	87	545	—	—	1·9	10	2	4	14	—	6·5	23	4·04
		Dec.	29·644	1·173	55·0	22·8	32·2	47·9	38·6	9·3	44·0	37·5	·226	2·6	0·7	78	545	—	—	1·5	6	8	8	9	—	8·3	26	5·29
TOTNES (Devon), T. H. Edmonds, Esq.	107	Oct.	29·748	1·319	67·2	30·2	37·0	58·6	43·3	15·3	50·7	46·8	·321	3·6	0·6	88	539	—	—	2·0	8	5	8	10	—	6·8	26	7·81
		Nov.	29·708	0·892	57·0	25·9	31·1	52·5	39·4	13·1	45·8	40·6	·255	2·9	0·6	83	545	—	—	3·8	8	3	4	20	—	5·8	27	6·17
		Dec.	29·627	1·169	54·7	16·2	38·5	47·3	38·2	9·1	42·9	36·9	·220	2·5	0·7	84	546	—	—	2·7	6	5	7	13	—	7·8	26	6·60
TORQUAY, Babbacombe (Devon), Edwin E. Glyde, Esq., F.M.S.	305	Oct.	29·500	1·466	65·7	34·3	31·4	57·2	45·2	12·0	50·9	46·8	·321	3·7	0·5	87	535	97·2	37·3	1·4	8	5	7	11	4·5	7·2	26	6·79
		Nov.	29·439	0·978	58·8	30·1	28·7	50·9	40·1	10·8	45·6	40·2	·250	2·8	0·7	82	540	89·6	31·6	2·0	7	2	4	17	5·6	6·2	24	3·98
		Dec.	29·349	1·212	54·2	20·4	33·8	46·7	39·0	7·7	43·2	39·7	·245	2·8	0·4	88	541	63·9	32·3	1·6	5	6	7	13	4·6	7·8	22	3·88
VENTNOR, (Isle of Wight) (Royal National Hospital for Consumption), Hartley Sagar, Esq.	80	Oct.	29·721	1·508	67·0	41·2	25·8	58·8	49·9	8·9	54·6	52·6	·398	4·5	0·3	93	534	—	—	1·5	4	9	9	9	6·5	7·0	22	8·00
		Nov.	29·658	1·002	60·3	33·3	27·0	51·9	43·0	8·9	46·8	40·8	·255	2·9	0·7	80	542	—	—	1·8	9	2	3	16	6·3	5·1	24	3·90
		Dec.	29·590	1·232	52·5	29·3	23·2	47·6	40·3	7·3	43·7	40·4	·251	2·9	0·3	88	545	—	—	1·3	7	8	6	10	6·0	7·3	20	3·15
OSBORNE (Isle of Wight), J. R. Mann, Esq.	172	Oct.	29·633	1·554	71·3	35·8	35·5	58·2	46·6	11·6	51·5	50·5	·368	4·2	0·1	95	536	89·2	42·2	0·1	7	6	8	10	—	6·5	19	6·63
		Nov.	29·559	0·990	59·2	27·2	32·0	50·4	40·2	10·2	44·7	40·8	·255	2·9	0·4	87	543	77·5	37·0	0·3	5	2	7	16	—	5·9	21	3·56
		Dec.	29·490	1·226	52·2	23·0	29·2	45·8	37·0	8·8	41·6	40·3	·250	2·9	0·1	95	545	61·4	35·4	0·1	5	4	11	11	—	7·7	22	2·54
SALISBURY (Wilton House), Wilts, Thomas Challis, Esq.	186	Oct.	29·610	1·556	70·0	27·0	43·0	58·1	40·2	17·9	49·3	45·9	·310	3·6	0·5	90	539	106·6	38·8	1·1	7	4	14	6	—	7·3	29	8·04
		Nov.	29·532	1·085	63·0	21·0	42·0	49·9	34·1	15·8	42·4	39·5	·247	2·8	0·4	90	545	73·3	32·7	1·7	12	1	4	18	—	6·4	24	4·80
		Dec.	29·464	1·170	62·0	16·5	45·5	46·7	34·9	11·8	41·2	38·5	·233	2·7	0·3	91	545	71·9	32·4	1·1	7	5	14	5	—	8·7	24	3·18
BRIGHTON, F. E. Sawyer, Esq., F.M.S.	206	July	29·684	1·038	74·7	50·3	24·4	69·7	54·5	15·2	60·6	55·6	·423	4·8	1·1	81	527	114·0	49·0	1·2	3	1	13	14	—	7·1	22	2·62
		Aug.	29·723	0·909	77·0	48·3	28·7	69·1	53·4	15·7	60·7	52·8	·392	4·4	1·6	74	528	111·7	47·0	1·2	0	2	7	13	—	6·8	13	2·11
		Sept.	29·637	1·132	71·0	40·4	30·6	62·9	49·7	13·2	55·5	48·7	·345	3·9	1·1	79	532	98·0	43·8	1·1	10	6	5	9	—	6·5	13	2·57
		Oct.	29·611	1·369	66·0	35·4	30·6	57·4	47·2	10·2	52·0	48·0	·335	3·8	0·6	86	535	—	39·8	1·1	7	8	8	8	—	7·6	22	8·45
		Nov.	29·515	1·054	60·0	28·8	31·2	49·1	39·6	9·5	44·0	39·6	·244	2·8	0·5	84	543	—	33·3	1·3	9	3	3	15	—	5·0	21	3·28
		Dec.	29·464	1·219	53·2	25·0	27·2	44·2	36·8	7·4	41·0	37·8	·227	2·6	0·6	89	546	—	31·6	0·9	7	7	8	9	—	7·9	19	2·47
BARNSTAPLE (Devon), William Knill, Esq.	43	Oct.	29·705	1·310	70·0	36·0	34·0	59·0	47·9	11·1	53·6	49·0	·349	3·9	0·6	88	538	—	—	1·2	4	7	11	9	—	4·3	21	7·38
		Nov.	29·724	0·920	61·0	28·0	33·0	51·6	42·0	9·6	46·4	41·4	·269	3·1	0·6	82	544	—	—	1·4	8	2	6	14	—	5·5	24	7·61
		Dec.	29·629	1·100	56·5	18·0	38·5	47·3	39·2	8·1	43·5	40·6	·253	3·0	0·3	90	546	—	—	1·2	8	7	9	7	—	5·3	23	7·11
BATH (Somerset), St. Gregory's College, Downside, Rev. T. J. Almond, O.S.B., F.M.S.	596	Oct.	29·175	1·514	64·9	33·1	31·8	54·9	43·7	11·2	49·0	46·7	·320	3·7	0·3	92	531	88·0	37·1	1·4	9	6	7	8	—	8·1	24	6·74
		Nov.	29·055	0·912	57·0	27·7	29·3	47·3	36·4	10·9	41·8	39·1	·240	2·8	0·3	91	537	88·6	31·0	1·8	5	5	6	14	—	6·4	22	6·17
		Dec.	28·994	1·166	54·0	18·4	40·6	43·5	35·2	8·3	39·6	38·0	·229	2·7	0·1	94	537	57·7	30·4	1·6	7	6	9	9	—	8·2	22	6·34

Names of Stations and Observers.	Height of Station above Sea Level.	Year 1882.	Pressure of Atmosphere in Month.		Temperature of Air in Month.						Mean Temperature.		Vapour.			Mean Degree of Humidity. Sat. = 100.	Mean Weight of a cubic foot of Air.	Mean Reading of Thermometer.		Wind.					Mean Amount of Ozone.	Mean Amount of Cloud.	Rain.	
								Mean						In a Cubic foot of Air.						Estimated Strength.	Relative Proportion of						
		Months.	Mean.	Range.	Highest.	Lowest.	Range.	Of all Highest.	Of all Lowest.	Daily Range.	Air.	Dew Point.	Elastic Force.	Mean.	Short of Saturation.			Maximum in Rays of Sun.	Minimum on Grass.		N.	E.	S.	W.			Number of Days it fell.	Amount collected.
	feet.		in.	in.	°	°	°	°	°	°	°	°	in.	grs.	gr.		grs.	°	°									in.
STRATHFIELD TURGISS (Hants), Rev. C. H. Griffith, M.A., F.M.S.	197	Oct.	29·825	1·535	69·0	27·9	41·1	57·4	42·9	14·5	49·9	47·0	·323	3·7	0·4	96	538	90·6	36·4	1·0	5	6	10	10	1·9	7·0	23	5·96
		Nov.	29·515	0·996	60·0	21·0	39·0	48·9	36·8	12·1	43·3	38·1	·233	2·6	0·5	83	544	77·3	30·7	1·2	6	2	6	16	1·9	5·3	22	2·91
		Dec.	29·475	1·206	57·0	15·4	38·6	44·3	34·3	10·0	39·9	37·3	·294	2·6	0·3	91	547	58·3	30·0	0·9	6	5	8	12	1·6	8·0	20	2·08
MARLBOROUGH (Wilts), Rev. Thomas A. Preston, M.A., F.M.S.	456	Oct.	29·315	1·610	66·0	28·3	37·7	55·2	43·1	12·1	48·6	46·5	·318	3·6	0·3	91	535	90·0	39·6	0·7	5	10	9	7	—	7·5	25	6·74
		Nov.	29·202	0·938	58·8	22·2	36·6	47·2	36·4	10·8	41·5	39·5	·243	3·8	0·2	93	540	81·2	33·0	1·0	6	4	3	17	—	6·2	23	4·30
		Dec.	29·149	1·192	54·1	11·8	42·3	42·7	34·6	8·1	38·9	36·6	·216	2·6	0·2	93	542	57·2	32·9	0·7	4	7	8	12	—	8·0	24	4·06
WHITCHURCH RECTORY (Oxon), (near Reading). Rev. J. Slatter, M.A., F.M.S.	150	Oct.	29·657	1·538	67·0	30·7	36·3	57·4	42·0	15·4	49·3	47·2	·334	3·8	0·2	93	539	—	—	1·4	5	11	7	8	—	7·4	19	5·04
		Nov.	29·562	0·913	60·8	23·3	38·5	48·5	36·3	12·2	42·5	39·9	·264	3·2	0·3	91	535	—	—	1·6	4	4	8	14	—	5·1	20	2·98
		Dec.	29·505	1·208	55·3	19·0	36·3	43·8	33·7	10·1	36·1	34·9	·203	2·4	0·1	95	552	—	—	0·9	7	6	8	10	—	7·2	19	2·90
BLACKHEATH (Kent), James Glaisher, Esq., F.R.S.	150	Oct.	29·664	1·745	71·0	32·3	38·7	56·8	45·8	11·5	50·8	46·3	·315	3·6	0·6	85	538	84·8	39·1	1·0	4	8	9	10	—	7·1	24	6·53
		Nov.	29·532	1·016	60·0	26·0	34·0	48·1	39·0	9·1	43·0	37·7	·296	2·6	0·6	81	544	80·1	32·9	1·5	4	3	3	20	—	6·2	17	2·50
		Dec.	29·515	1·391	56·0	24·0	32·0	43·8	36·0	7·8	39·7	37·4	·224	2·6	0·2	92	549	52·1	36·0	0·9	4	7	9	11	—	7·8	18	2·08
ROYAL OBSERVATORY, Greenwich, W. H. M. Christie, M.A., F.R.S., Astronomer Royal.	160	Oct.	29·656	1·707	71·1	30·6	40·5	57·7	44·7	12·9	50·8	47·6	·330	3·7	0·5	89	537	87·6	39·5	—	—	—	—	—	3·4	7·6	23	5·42
		Nov.	29·533	1·040	60·1	24·4	35·7	48·9	38·4	10·3	43·5	38·6	·234	2·7	0·5	83	544	71·4	32·8	—	—	—	—	—	4·0	6·5	19	2·20
		Dec.	29·493	1·261	56·9	22·2	34·7	44·0	35·5	8·4	40·1	37·6	·225	2·6	0·3	91	547	50·6	32·1	—	—	—	—	—	2·1	8·2	17	1·77
CAMDEN SQUARE (London). G. J. Symons, Esq., F.R.S., F.M.S.	123	Oct.	29·694	1·467	70·4	31·9	38·5	58·0	44·5	13·5	51·0	46·5	·318	3·6	0·6	85	536	80·8	41·6	—	10	6	5	9	—	7·7	23	4·96
		Nov.	29·558	1·040	61·8	25·4	33·4	49·4	38·2	11·2	43·5	37·5	·221	2·5	0·7	78	544	70·0	34·3	—	7	4	5	14	—	5·9	18	2·57
		Dec.	29·528	1·271	57·2	24·5	32·7	44·3	35·5	8·8	40·5	38·5	·232	2·8	0·2	93	547	49·9	33·8	—	7	5	5	13	—	8·1	16	2·51
BARNET (Gas Works). T. H. Martin, Esq., C.E.	212	Oct.	29·626	1·096	69·5	26·0	43·5	57·4	42·0	15·4	49·3	46·8	·321	3·7	0·4	92	539	68·2	37·3	1·0	6	10	8	7	—	7·4	24	5·30
		Nov.	29·503	0·990	62·0	17·2	44·8	48·9	36·6	12·3	42·5	37·2	·222	2·6	0·6	82	544	—	30·5	1·6	12	3	3	12	—	6·1	17	2·70
		Dec.	29·468	1·268	57·9	13·6	44·3	42·4	32·5	9·9	38·2	36·3	·214	2·5	0·2	93	549	—	27·5	0·8	9	8	5	9	—	7·6	11	1·21
OXFORD (The Observatory), E. J. Stone, Esq., M.A., F.R.S.	210	Oct.	29·595	1·741	67·2	31·8	35·4	56·8	45·0	11·8	50·4	47·5	·329	3·7	0·4	90	537	91·1	39·0	2·4	6	7	10	8	1·0	7·3	20	5·76
		Nov.	29·476	0·965	59·7	22·7	37·0	49·8	39·1	10·5	43·7	40·9	·256	2·9	0·3	90	543	83·3	33·9	3·9	6	2	7	15	1·8	5·6	28	3·34
		Dec.	29·430	1·217	54·9	17·8	37·1	44·6	35·6	9·0	40·1	37·8	·227	2·6	0·3	92	546	62·6	32·2	2·6	6	5	10	10	1·0	7·7	18	2·92
BURSLEM, J. E. Worth, Esq., C.E.	556	Oct.	29·217	1·413	64·6	29·3	35·3	53·6	42·3	11·3	47·4	43·8	·286	3·3	0·5	88	534	—	—	0·5	3	12	10	6	—	7·2	28	4·85
		Nov.	29·059	0·957	56·5	26·6	29·9	46·3	35·7	10·6	40·6	37·0	·219	2·5	0·4	87	538	—	—	0·5	6	4	6	14	—	5·8	25	5·48
		Dec.	29·021	1·241	52·7	15·6	37·1	40·5	33·6	6·9	37·2	35·1	·204	2·4	0·3	92	541	—	—	0·5	7	4	11	9	—	8·8	22	4·88
ROYSTON (Hertfordshire), Hale Wortham, Esq., F.R.A.S., F.M.S.	269	Oct.	29·562	1·658	68·7	32·9	35·8	56·8	43·9	12·9	49·8	46·8	·313	3·6	0·5	88	537	—	—	—	6	7	9	9	—	7·1	21	5·20
		Nov.	29·412	0·962	59·3	24·3	35·0	47·5	36·9	10·6	42·3	37·3	·223	2·5	0·6	82	543	—	—	—	6	2	6	16	—	6·1	18	3·22
		Dec.	29·389	1·256	54·3	19·1	35·2	42·6	33·4	9·2	38·3	35·6	·212	2·4	0·3	91	547	—	—	—	4	5	12	10	—	7·8	21	2·68
BEDFORD, Cardington, Mr. J. McLaren, Assistant to S. Whitbread, Esq., M.P.	105	Oct.	29·694	1·480	70·4	28·6	41·8	57·7	43·6	14·1	50·0	47·7	·332	3·8	0·3	92	539	69·9	39·7	1·3	6	5	12	8	—	7·3	24	4·75
		Nov.	29·587	0·850	61·4	23·6	37·8	48·8	36·2	12·6	42·2	38·2	·231	2·7	0·4	87	546	57·1	31·8	2·3	7	1	6	16	—	5·7	15	3·74
		Dec.	—	—	56·0	17·0	39·0	43·8	32·7	11·1	38·6	36·7	·218	2·5	0·3	92	550	44·5	31·1	1·2	6	4	9	12	—	8·3	16	2·54
CAMBRIDGE (Trinity College). J. W. L. Glaisher, Esq., M.A., F.R.S.	40	Oct.	29·763	1·518	71·8	31·0	40·8	58·6	44·1	14·5	50·6	48·1	·338	3·8	0·4	92	540	95·3	38·0	1·0	5	10	9	7	—	7·3	22	4·75
		Nov.	29·616	1·084	63·2	22·0	41·2	48·6	37·6	11·0	42·8	37·8	·227	2·6	0·6	88	546	80·2	30·2	1·4	7	2	9	12	—	5·6	22	2·47
		Dec.	29·595	1·272	56·8	19·0	37·8	43·1	33·7	9·4	39·0	36·9	·219	2·5	0·3	93	550	56·4	28·6	0·9	6	4	13	8	—	7·7	25	2·48
RUGBY (Warwickshire), Stockton, The Rectory, Rev. W. Tuckwell.	269	Oct.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
		Nov.	29·285	0·920	58·0	15·5	42·5	48·1	34·7	13·4	41·2	38·6	·235	2·7	0·4	92	542	—	—	0·7	6	1	11	12	3·1	5·4	22	4·24
		Dec.	29·235	1·180	54·5	10·0	44·5	42·5	31·6	10·9	37·6	35·4	·210	2·4	0·2	93	545	—	—	0·4	6	6	8	11	3·6	8·1	24	2·92

Names of Stations and Observers.	Height of Station above Sea Level.	Year 1882.	Pressure of Atmosphere in Month.		Temperature of Air in Month.						Mean Temperature.		Vapour.				Mean Degrees of Humidity. Sat.n. = 100.	Mean Weight of a cubic foot of Air.	Mean Reading of Thermometer.		Wind.					Mean Amount of Ozone.	Mean Amount of Cloud.	Rain.	
								Mean						In a cubic foot of Air.							Estimated Strength.	Relative Proportion of							
		Months.	Mean.	Range.	Highest.	Lowest.	Range.	Of all Highest.	Of all Lowest.	Daily Range.	Air.	Dew Point.	Elastic Force.	Mean.	Short of Saturation.				Maximum in Rays of Sun.	Minimum on Grass.		N.	E.	S.	W.			Number of Days it fell.	Amount collected.
	feet.		in.	in.	°	°	°	°	°	°	°	°	in	grs.	gr.			grs.	°	°								in.
LOWESTOFT (Suffolk), S. H. Miller, Esq., F.R.A.S., F.M.S.	89	Oct.	29·730	1·686	66·9	35·6	31·3	58·7	46·8	9·9	51·6	47·6	·329	3·7	0·5	85	538	87·0	44·2	0·4	2	11	8	10	—	7·1	19	4·92
		Nov.	29·515	0·932	59·5	29·8	29·7	48·9	38·6	10·3	43·6	38·8	·236	2·7	0·5	83	544	80·0	37·3	0·6	6	4	5	15	—	6·7	22	3·48
		Dec.	29·544	1·426	55·0	21·0	34·0	43·5	35·2	8·3	39·6	36·8	·219	2·5	0·5	90	548	64·6	33·5	0·3	4	5	9	13	—	7·2	21	3·67
SOMERLEYTON (Suffolk), The Rectory, Rev. C. J. Steward, F.M.S.	50	Oct.	29·781	1·086	67·3	31·0	36·3	57·2	46·2	11·0	50·7	47·2	·326	3·7	0·5	88	540	—	—	1·1	4	11	9	7	5·6	6·4	20	5·05
		Nov.	29·605	0·936	59·2	26·0	33·2	47·9	37·9	10·0	42·4	37·9	·230	2·6	0·5	85	546	—	—	1·2	4	6	7	15	5·8	5·8	24	3·29
		Dec.	29·590	1·342	55·5	19·8	35·7	43·5	34·3	9·2	38·8	37·0	·220	2·6	0·1	93	550	—	—	0·9	2	.6	14	9	5·3	7·3	22	3·90
WOLVERHAMPTON (Staffordshire), Wrottesley, E. Simpson, Esq.	500	Oct.	29·805	1·336	64·8	30·9	33·9	54·1	41·1	13·0	46·8	44·5	·287	3·3	0·3	92	536	—	—	—	6	10	11	4	—	8·1	21	5·80
		Nov.	29·174	0·924	57·8	24·5	33·3	46·9	34·5	12·4	40·4	36·8	·244	2·5	0·5	86	541	—	—	—	7	2	11	10	—	6·1	22	3·97
		Dec.	29·134	1·158	54·8	18·0	36·8	41·5	31·8	9·7	37·1	35·0	·203	2·4	0·2	92	548	—	—	—	5	8	10	8	—	8·4	21	3·93
LEICESTER (Town Museum), J. C. Smith, Esq.	238	Oct.	29·553	1·357	67·4	30·2	37·2	56·6	43·7	12·9	49·7	45·8	·307	3·5	0·5	88	537	84·2	38·7	0·5	7	8	8	8	—	6·7	23	5·55
		Nov.	29·386	1·035	58·5	22·0	36·5	47·0	37·0	10·0	42·0	37·2	·223	2·6	0·5	84	543	71·8	31·8	0·9	5	3	9	13	—	4·3	26	2·27
		Dec.	29·376	1·372	50·0	16·4	33·6	42·6	34·3	8·3	39·5	33·1	·180	2·2	0·5	78	546	49·1	32·7	0·7	7	5	8	11	—	8·6	22	3·91
NOTTINGHAM (Notts), M.O. Tarbotton, Esq., C.E., F.G.S., F.M.S.	183	Oct.	29·619	1·416	67·7	30·3	37·4	55·7	42·6	13·1	48·4	44·7	·296	3·3	0·5	87	540	78·1	41·5	0·3	3	14	9	5	0·9	7·7	27	5·08
		Nov.	29·450	0·972	60·1	23·2	36·9	47·5	35·5	12·0	41·1	37·3	·222	2·6	0·4	87	545	64·6	33·2	0·3	6	4	8	12	1·0	6·6	24	3·18
		Dec.	29·420	1·298	54·8	17·5	37·3	41·4	33·1	8·3	37·6	35·7	·210	2·5	0·2	93	548	47·5	31·6	0·3	8	10	6	7	1·4	9·4	23	4·25
HOLKHAM (Norfolk), John Davidson, Esq., Assistant to the Earl of Leicester.	39	Oct.	29·765	1·794	69·1	29·3	39·8	56·4	41·1	15·3	49·3	46·9	·336	3·7	0·3	93	541	81·9	34·1	1·4	3	10	14	4	—	7·4	18	3·63
		Nov.	29·607	1·258	68·7	25·4	33·3	47·1	35·6	11·5	41·7	39·3	·241	2·8	0·2	92	547	56·5	31·0	2·0	7	3	12	9	—	7·0	18	3·60
		Dec.	29·584	1·370	53·7	18·2	35·5	43·4	32·3	11·1	38·5	36·8	·219	2·6	0·2	94	550	47·6	27·0	1·1	4	7	14	6	—	8·6	12	3·12
LLANDUDNO (Carnarvonshire), James Nicol, Esq., M.D.	197	Oct.	29·707	1·480	71·2	38·4	32·8	55·1	46·4	8·7	50·6	45·7	·307	3·5	0·6	83	539	—	—	1·1	2	7	14	8	—	6·9	20	2·64
		Nov.	29·523	1·230	56·1	30·2	25·9	48·3	40·3	8·0	44·8	40·0	·248	2·8	0·6	84	542	—	—	1·4	5	5	8	12	—	7·4	23	3·21
		Dec.	29·515	1·160	53·2	25·5	29·7	43·8	37·4	6·4	41·0	36·9	·219	2·5	0·5	86	546	—	—	1·2	2	9	11	9	—	7·6	19	3·56
BOLTON, Sharples (Lancashire), Rev. T. Mackereth, F.R.A.S., F.M.S.	500	Oct.	29·377	1·436	66·4	34·0	32·4	53·9	43·7	11·2	48·2	44·2	·290	3·3	0·5	87	534	61·4	37·5	1·4	6	10	9	6	1·5	7·9	23	4·01
		Nov.	29·082	1·090	55·7	26·1	29·6	46·0	35·5	10·5	40·9	36·8	·218	2·5	0·5	86	538	49·8	29·1	2·9	8	4	8	12	3·7	7·1	24	3·07
		Dec.	29·075	1·258	51·5	18·4	33·1	40·9	32·4	8·5	37·2	33·9	·195	2·2	0·4	88	542	41·3	27·0	1·6	7	8	8	8	2·3	7·6	24	2·26
HALIFAX, Bermeraide Observatory (Yorkshire), E. J. Crossley, Esq., F.R.A.S.	530	Oct.	29·304	1·456	67·8	30·0	37·8	54·7	42·2	12·5	48·2	44·6	·295	3·4	0·5	88	534	79·8	40·2	0·6	7	10	7	7	—	7·3	24	4·44
		Nov.	29·155	1·054	56·9	20·9	36·0	45·5	36·0	9·5	40·4	37·4	·224	2·6	0·4	90	540	66·2	33·4	1·1	4	5	9	12	—	6·6	26	6·51
		Dec.	29·093	1·276	52·0	13·0	39·0	38·4	32·1	6·3	35·6	34·1	·190	2·2	0·3	91	545	48·9	31·0	0·6	6	8	8	9	—	8·5	23	5·05
HULL (Yorkshire), The People's Park, Mr. E. Peak.	12	Oct.	29·831	1·374	70·0	32·0	38·0	56·7	44·0	12·7	50·6	48·7	·320	3·6	0·5	87	541	71·5	41·4	1·5	4	6	8	13	—	6·6	23	5·23
		Nov.	29·602	1·078	60·0	28·0	32·0	47·8	33·7	14·1	41·7	37·2	·220	2·5	0·5	86	547	56·9	31·2	1·9	4	13	10	13	—	5·9	24	2·95
		Dec.	29·536	1·316	54·0	14·0	40·0	40·6	33·1	6·5	37·8	35·5	·206	2·4	0·3	92	552	43·9	30·9	1·3	5	7	10	9	—	7·5	20	5·17
STONYHURST (Lancashire), Rev. S. J. Perry, F.R.S., F.M.S., F.R.A.S.	363	Oct.	29·431	1·433	66·0	30·0	36·0	55·8	42·8	13·8	48·6	44·2	·294	3·3	0·6	85	536	58·6	41·7	—	9	8	7	7	—	9·0	23	4·69
		Nov.	29·213	1·163	56·2	25·5	30·7	46·9	34·7	12·2	40·8	36·8	·217	2·5	0·5	86	541	71·8	33·0	—	6	3	7	14	—	7·6	24	3·18
		Dec.	29·247	1·250	53·0	17·0	36·0	42·0	32·3	9·7	37·2	33·3	·191	2·2	0·4	83	546	58·3	31·1	—	10	7	•5	9	—	8·4	21	3·75
BRADFORD (Yorkshire), J. McLandsborough, Esq., C.E., F.G.S.	366	Oct.	29·484	1·470	67·2	34·8	32·4	55·0	45·7	9·3	49·5	45·6	·306	3·5	0·5	87	535	66·8	—	1·0	4	8	9	10	—	7·1	27	4·08
		Nov.	29·228	1·104	56·2	24·0	32·2	46·4	37·7	8·7	41·7	38·8	·219	2·5	0·5	84	540	54·5	—	1·1	8	5	5	12	—	6·8	27	5·17
		Dec.	29·200	1·306	53·2	18·6	34·6	40·6	33·5	7·1	37·4	34·6	·200	2·3	0·3	90	545	45·1	—	1·2	9	3	6	13	—	8·6	25	4·51
LEEDS (Yorkshire), The Philosophical Hall, Henry Crowther, Esq.	187	Oct.	29·674	1·464	66·0	35·0	33·0	56·0	45·9	10·1	50·5	47·2	·325	3·8	0·5	89	538	—	—	1·1	5	11	7	8	—	7·7	21	3·64
		Nov.	29·442	1·128	58·0	25·0	33·0	47·2	38·7	8·5	42·9	39·1	·259	2·8	0·4	87	543	—	—	1·2	5	4	7	14	—	7·5	26	2·98
		Dec.	29·464	1·354	55·0	18·0	37·0	41·5	34·8	7·2	38·4	34·7	·206	2·4	0·4	87	545	—	—	1·1	8	7	6	10	—	8·8	23	2·98

Names of Stations and Observers.	Height of Station above Sea Level.	Year 1882. Months.	Pressure of Atmosphere in Month. Mean.	Pressure of Atmosphere in Month. Range.	Temperature of Air in Month. Highest.	Lowest.	Range.	Mean Of all Highest.	Mean Of all Lowest.	Mean Daily Range.	Mean Temperature. Air.	Dew Point.	Vapour. Elastic Force.	In a cubic foot of Air. Mean.	Short of Saturation.	Mean Degree of Humidity. Sat. = 100.	Mean Weight of cubic foot of Air.	Mean Reading of Thermometer. Maximum in Rays of Sun.	Minimum on Grass.	Wind. Estimated Strength.	Relative Proportion of N.	E.	S.	W.	Mean Amount of Ozone.	Mean Amount of Cloud.	Rain. Number of Days it fell.	Amount collected.
	feet.		in.	in.	°	°	°	°	°	°	°	°	in.	grs.	gr.		grs.	°	°								in.	
LANCASTER (Southfields), William Roper, Esq.	114	Oct.	29·693	1·404	67·0	34·0	38·0	56·8	44·1	12·2	49·8	45·9	·312	3·5	0·5	87	540	—	—	—	—	—	—	—	—	—	18	3·32
		Nov.	29·513	1·014	56·0	27·0	29·0	47·3	36·5	10·8	41·9	37·3	·226	2·6	0·5	88	545	—	—	—	—	—	—	—	—	—	22	6·71
		Dec.	29·506	1·194	51·0	21·0	30·0	42·1	33·4	8·7	38·2	34·0	·195	2·3	0·5	85	550	—	—	—	—	—	—	—	—	—	15	3·71
SILLOTH (Cumberland), "The Rectory," Rev. F. Redford, M.A., F.R.A.S., F.M.S.	28	Oct.	29·768	1·521	70·0	32·0	38·0	55·4	44·4	11·0	49·0	45·6	·307	3·5	0·7	88	542	94·2	40·7	1·5	4	14	7	6	9·0	5·8	19	3·11
		Nov.	29·535	1·358	54·8	25·1	29·7	45·8	36·3	9·5	40·7	37·0	·220	2·5	0·4	88	547	79·0	32·1	1·8	8	3	5	14	10·4	5·5	21	4·82
		Dec.	29·570	1·250	50·2	17·5	32·7	39·9	32·2	7·7	36·2	33·2	·190	2·2	0·3	89	553	61·7	29·3	1·4	7	12	5	7	8·9	6·6	19	3·07
CARLISLE, Spital (Cumberland), Isaac Cartmel, Esq., F.M.S.	114	Oct.	29·676	1·634	68·8	29·2	39·6	56·1	42·4	13·7	49·0	44·2	·291	3·3	0·7	84	530	76·2	34·6	0·9	3	14	6	8	8·9	7·8	22	2·76
		Nov.	29·446	1·426	56·3	22·6	33·7	46·4	33·5	12·9	40·1	36·2	·214	2·5	0·4	86	546	55·4	25·8	1·1	2	7	4	17	9·6	6·7	18	7·26
		Dec.	29·469	1·260	51·8	15·5	36·3	40·5	30·4	10·1	36·1	33·7	·194	2·2	0·3	91	551	47·6	23·4	1·0	4	10	4	13	8·2	8·5	15	2·56

Second Rain-gauges are placed—

			October.		November.		December.		Total in Quarter.
At Oxford, at the height of	22	feet *above the ground;* the amount collected was	5·56	inches.	3·16	inches.	2·67	inches.	11·39 inches.
,, Cardington, ,,	21	,, ,, ,,	4·45	,,	3·50	,,	2·30	,,	10·25 ,,
,, Nottingham, ,,	39	,, ,, ,,	4·79	,,	2·77	,,	4·48	,,	12·04 ,,
,, Holkham, ,,	4	,, ,, ,,	3·90	,,	3·42	,,	3·04	,,	10·45 ,,

In December on the 2nd at Bath; on the 3rd at Plymouth and Bath; on the 4th, 5th, 6th, 7th, 8th, and 10th at Guernsey; on the 4th at Llandudno and Truro; on the 5th and 6th at Truro; on the 7th at Lowestoft; and on the 23rd at Bath.

Fog prevailed in October on the 4th at Hull; on the 8th at Barnet, Oxford, Cambridge, Wolverhampton, and Hull; on the 9th at Totnes, Torquay, Barnet, Oxford, Burslem, Lowestoft, Cambridge, Wolverhampton, Bolton, Hull, and Stonyhurst; on the 10th at Guernsey, Totnes, Barnet, Oxford, Somerleyton, Lowestoft, Cambridge, Wolverhampton, and Stonyhurst; on the 11th at Cambridge; on the 12th at Oxford; on the 13th at Oxford, Somerleyton, and Cambridge; on the 14th at Totnes; on the 15th at Plymouth; on the 18th at Totnes, Barnet, Wolverhampton; on the 19th at Totnes, and Hull; on the 20th at Barnet, Oxford, and Wolverhampton; on the 21st at Torquay, Totnes, and Hull; on the 24th at Bolton; on the 25th at Totnes, Barnet, Oxford, Cambridge, and Bolton; on the 26th at Totnes, Barnet, Oxford, Somerleyton, Hull, and Stonyhurst; on the 27th at Wolverhampton.

In November on the 1st at Hull; on the 6th at Totnes, Cambridge, and Bolton; on the 7th at Blackheath, Wolverhampton, and Stonyhurst; on the 11th at Blackheath; on the 12th at Whitchurch, Blackheath, Barnet, Oxford, Royston, Cardington, Cambridge, and Wolverhampton; on the 13th at Strathfield Turgiss; on the 15th at Oxford; on the 17th at Oxford, Bolton, Hull; on the 18th at Torquay, Whitchurch, Blackheath, Barnet, and Cambridge; on the 19th at Bolton; on the 20th and 21st at Blackheath; on the 28th at Oxford; on the 29th at Hull and Bradford; on the 30th at Oxford, Bolton, and Llandudno.

In December on the 1st at Barnet, Oxford, and Cardington; on the 2nd at Salisbury, Oxford, Cardington, Cambridge, Barnet, and Bradford; on the 3rd at Torquay, Barnet, Lowestoft, Cambridge; on the 6th at Somerleyton; on the 9th at Cambridge and Bolton; on the 10th at Osborne, Bath, Barnet, Oxford, Bolton, and Bradford; on the 11th at Osborne, Barnet, Burslem, Somerleyton, Cambridge, Bolton, and Bradford; on the 12th at Bath, Burslem, Somerleyton, Llandudno, and Bradford; on the 13th at Torquay, Bath, Cardington, and Llandudno; on the 14th at Osborne, Bath, Barnet, Oxford, Cardington, Somerleyton, Lowestoft, Cambridge, Wolverhampton, Llandudno, and Halifax; on the 15th at Osborne, Cardington, Barnet, Somerleyton, Lowestoft, Cambridge, Wolverhampton, Halifax, and Bradford; on the 16th at Osborne, Somerleyton, Lowestoft, Barnet, Cambridge, Wolverhampton, Halifax, and Bradford; on the 17th at Osborne, Barnet, Cardington, Somerleyton, Lowestoft, Halifax, and Bradford; on the 18th at Torquay, Llandudno, Halifax, and Bradford; on the 19th at Guernsey, Truro, Torquay, Cambridge, Wolverhampton, Llandudno, Halifax, and Bradford; on the 20th at Truro, Plymouth, Torquay, Barnet, and Cambridge; on the 20th at Barnet; on the 24th at Bolton; on the 25th at Somerleyton, Burslem, Barnet, Cambridge, and Bradford; on the 27th at Bolton; and on the 31st at Guernsey, Torquay, Cardington, Somerleyton, Lowestoft, and Cambridge.

NAMES OF STATIONS.	Mean Pressure of dry Air reduced to the level of the Sea.	Highest Reading of the Thermometer.	Lowest Reading of the Thermometer.	Range of Temperature in the Quarter.	Mean of all Highest.	Mean of all Lowest.	Mean Monthly Range of Temperature.	Mean Daily Range of Temperature.	Mean Temperature of the Air.	Mean Temperature of the Dew Point.	Mean Elastic Force of Vapour.	Mean Weight of Vapour in a cubic foot of Air.	Mean additional Weight required for saturation.	Mean degree of Humidity.	Mean Weight of a cubic foot of Air.	Mean Reading of Maximum in Rays of Sun.	Mean Reading of Minimum on Grass.	Wind. Mean Estimated Strength.	Wind. Relative Proportion of N.	Wind. Relative Proportion of E.	Wind. Relative Proportion of S.	Wind. Relative Proportion of W.	Mean Amount of Ozone.	Mean Amount of Cloud.	Rain. Number of Days on which it fell.	Rain. Amount collected.
	in.	°	°	°	°	°	°	°	°	°	in.	grs.	gr.		grs.	°	°									in.
Guernsey	29·497	66·3	30·0	36·3	52·6	44·9	25·3	7·8	48·5	44·7	·294	3·4	0·6	87	537	79·7	41·1	1·2	5	4	10	12	4·5	7·7	85	21·61
Truro	29·456	71·0	22·0	44·0	53·6	48·1	33·3	10·5	47·8	43·8	·288	3·2	0·5	87	542	—	—	2·6	7	4	7	12	—	7·7	79	18·34
Plymouth	29·508	64·9	22·8	42·1	52·2	41·6	30·7	10·6	46·9	42·2	·274	3·1	0·6	84	543	—	—	1·6	8	6	6	10	—	7·6	71	15·72
Totnes	29·547	67·2	24·2	51·0	53·8	40·3	35·5	12·5	46·5	41·4	·265	3·0	0·6	85	543	—	—	2·8	6	4	6	14	—	6·8	79	19·20
Torquay	29·483	65·7	20·4	45·3	51·6	41·4	31·3	10·2	46·6	42·2	·272	3·1	0·5	86	539	83·6	33·7	1·7	7	4	6	14	4·9	7·1	72	14·60
Ventnor	29·442	67·0	29·3	37·7	52·8	44·4	25·3	8·4	48·4	44·6	·301	3·4	0·4	87	540	—	—	1·5	7	6	6	12	6·3	6·5	66	15·60
Osborne	29·457	71·3	23·0	48·3	51·5	41·3	32·2	10·2	45·9	43·9	·291	3·3	0·2	92	541	76·0	38·2	0·2	6	4	9	12	—	6·7	62	12·77
Salisbury	29·472	70·0	16·5	53·5	51·6	38·4	43·5	15·2	44·3	41·3	·238	3·0	0·4	90	543	84·6	34·6	1·3	9	3	11	8	—	7·5	77	15·85
Barnstaple	29·476	70·0	18·0	52·0	52·6	43·0	35·2	9·6	47·5	44·0	·287	3·8	0·5	87	543	—	—	1·3	7	5	9	10	—	4·4	68	22·10
Bath	29·462	64·9	13·4	51·5	48·6	38·5	33·9	10·1	43·5	41·8	·263	3·1	0·2	92	535	76·4	32·8	1·6	7	6	7	10	—	7·6	82	19·72
Strathfield Turgiss	29·494	63·0	18·4	50·6	50·2	38·0	30·6	12·2	44·4	40·8	·260	3·0	0·4	90	543	75·4	32·4	1·0	6	4	8	13	1·8	6·8	65	16·64
Marlborough	29·481	66·0	11·8	54·2	48·4	38·0	35·9	10·3	43·0	40·9	·259	3·0	0·2	92	539	76·1	35·2	0·5	5	7	7	12	—	7·2	72	15·10
Whitchurch	29·473	67·0	19·0	48·0	49·9	37·3	37·0	12·6	42·6	40·7	·267	3·1	0·2	93	542	—	—	1·3	5	7	8	11	—	6·6	58	10·87
Blackheath	29·489	71·0	24·0	47·0	49·6	40·1	34·9	9·5	44·5	40·5	·255	2·9	0·5	86	544	72·1	36·0	1·1	4	6	7	14	—	7·0	59	11·05
Camden Square	29·470	70·4	24·5	45·9	50·5	39·4	34·9	11·2	45·0	41·8	·257	3·0	0·5	86	543	66·9	36·6	—	8	5	5	13	—	7·2	57	10·01
Barnet	29·510	69·5	13·6	55·9	49·6	37·0	44·2	12·5	43·3	40·1	·252	2·9	0·4	89	544	—	31·8	1·1	9	7	5	9	—	7·0	62	12·60
Oxford	29·459	67·2	17·8	49·4	50·3	39·9	36·5	10·4	44·7	42·1	·271	3·1	0·3	91	542	78·9	34·8	3·0	6	5	9	11	1·3	6·9	66	12·90
Burslem	29·464	64·6	15·6	49·0	48·8	37·2	34·1	9·4	41·7	38·6	·236	3·7	0·4	89	538	—	—	0·5	5	7	9	10	—	7·3	75	15·21
Royston	29·498	68·7	19·1	49·6	49·0	38·1	35·3	10·9	43·5	39·7	·249	2·8	0·5	87	542	—	—	5·5	9	12	—	—	7·0	60	11·10
Cardington	—	70·4	17·0	53·4	50·1	37·5	39·5	12·6	43·6	40·9	·260	3·0	0·3	90	545	57·2	34·2	1·6	6	3	9	12	—	7·1	55	11·10
Cambridge	29·448	71·8	19·0	52·8	50·1	38·5	39·9	11·6	44·1	40·9	·261	3·0	0·4	89	545	77·3	32·3	1·1	6	5	10	9	—	6·0	69	9·50
Lowestoft	29·434	63·9	21·0	45·9	49·7	40·2	31·7	9·5	44·9	41·1	·261	3·0	0·5	86	543	77·2	38·3	0·4	14	7	7	13	—	7·0	62	12·07
Somerleyton	29·456	67·3	19·8	47·5	49·5	39·5	35·1	10·1	44·0	40·7	·258	3·0	0·4	89	545	—	—	1·1	3	3	10	10	5·6	6·5	66	12·24
Wolverhampton	29·414	64·8	13·0	48·8	47·5	35·8	34·7	11·7	41·4	38·6	·235	2·7	0·3	90	542	—	—	1·6	6	7	11	7	—	7·3	64	13·50
Leicester	29·431	67·4	16·4	51·0	48·7	38·3	37·4	10·4	43·7	38·7	·240	2·8	0·5	88	542	68·4	31·4	0·7	6	5	8	11	—	6·3	76	12·75
Nottingham	29·452	67·7	17·5	50·2	48·2	37·1	37·2	11·1	42·4	39·2	·243	2·8	0·4	89	544	68·4	35·4	0·3	6	9	8	8	1·1	7·9	74	12·46
Holkham	29·433	69·1	18·2	50·9	48·9	33·3	36·2	12·6	43·2	41·0	·262	3·0	0·2	93	546	61·0	30·7	1·5	5	7	13	6	—	7·7	48	10·55
Llandudno	29·540	71·2	25·5	45·7	49·1	41·4	29·8	7·7	45·5	40·9	·258	2·9	0·6	84	542	—	—	1·2	3	7	11	10	—	7·8	62	10·11
Bolton	29·456	66·4	18·4	48·0	46·9	33·9	31·7	10·1	42·1	38·3	·234	2·7	0·5	87	538	50·8	31·2	2·0	6	7	8	9	2·5	7·5	71	17·34
Halifax	29·524	67·8	13·0	51·8	46·2	38·8	37·6	9·4	41·4	38·7	·236	2·7	0·4	90	540	65·0	34·9	0·8	6	8	8	9	—	7·5	73	16·05
Hull	29·459	70·0	14·0	56·0	48·4	36·6	38·3	11·8	43·4	40·5	·250	2·8	0·4	85	547	57·4	34·5	1·6	4	5	9	12	—	6·7	67	11·40
Stonyhurst	29·458	66·0	17·4	49·0	48·2	35·6	34·4	11·6	42·2	38·1	·234	2·7	0·5	85	541	72·9	35·3	—	8	6	6	10	—	8·3	68	16·35
Bradford	29·446	67·2	18·6	48·6	47·3	38·9	33·1	8·4	43·9	39·0	·242	2·8	0·4	87	540	55·5	—	1·1	7	5	7	12	—	7·5	79	13·26
Leeds	29·426	68·0	18·0	50·0	48·2	39·6	34·3	8·6	43·9	40·3	·257	3·0	0·4	88	542	—	—	1·1	6	7	7	11	—	8·0	70	9·60
Lancaster	29·454	67·0	21·0	46·0	44·6	34·0	30·7	10·6	43·3	39·1	·244	2·8	0·5	86	545	—	—	—	—	—	—	—	—	—	55	13·74
Silloth	29·416	70·0	17·5	52·5	47·0	37·6	33·5	9·4	42·0	38·6	·239	2·7	0·5	88	547	78·3	31·0	1·6	6	10	6	9	9·4	6·0	59	11·40
Carlisle	29·421	68·8	15·5	53·3	47·7	35·4	33·5	12·2	41·7	38·0	·233	2·7	0·5	87	542	59·7	27·9	1·0	3	10	5	13	3·6	7·7	55	10·55

The highest temperatures of the air were at Cambridge, 71°·8; at Osborne, 71°·3; and at Llandudno, 71°·2.
The lowest temperatures of the air were at Marlborough, 11°·8; at Halifax, 13°; and at Bath, 13·4°.
The greatest daily ranges of temperatures were at Salisbury, 15°·2; and at Whitchurch, Cardington, and Holkham, 12°·6.
The least daily ranges of temperatures were at Llandudno, 7°·7; at Guernsey, 7°·8; and at Ventnor and Bradford, 8°·4.
The greatest number of days of rain were at Guernsey, 85; at Truro, Bradford, and Totnes, 79.
The least number of days of rain were at Holkham, 48; at Barnet, 52; and at Cardington, Lancaster, and Carlisle, 55.
The greatest falls of rain in the quarter were at Barnstaple, 22·10 inches; at Guernsey, 21·65 inches; and at Totnes, 20·23 inches.
The least falls of rain in the quarter were at Barnet, 9·21 inches; at Leeds 9·60 inches; and at Cambridge, 9·70 inches.

Quarterly Meteorological Table for different Parallels of Latitude.

PARALLELS OF LATITUDE, &c.	Mean Pressure of dry Air reduced to the level of the Sea.	Mean of all Highest Readings of the Thermometer.	Mean of all Lowest Readings of the Thermometer.	Mean Range of Temperature in the Quarter.	Mean of all Highest.	Mean of all Lowest.	Mean Monthly Range of Temperature.	Mean Daily Range of Temperature.	Mean Temperature of the Air.	Mean Temperature of the Dew Point.	Mean Elastic Force of Vapour.	Mean Weight of Vapour in a cubic foot of Air.	Mean additional Weight required for saturation.	Mean degree of Humidity.	Mean Weight of a cubic foot of Air.	Mean Reading of Maximum in Rays of Sun.	Mean Reading of Minimum on Grass.	Wind. Mean Estimated Strength.	Wind. Relative Proportion of N.	Wind. Relative Proportion of E.	Wind. Relative Proportion of S.	Wind. Relative Proportion of W.	Mean Amount of Ozone.	Mean Amount of Cloud.	Rain. Mean Number of Days it fell.	Rain. Mean Amount collected.
	in.	°	°	°	°	°	°	°	°	°	in.	grs.	gr.		grs.	°	°									in.
Guernsey	29·497	66·3	30·0	36·3	52·6	44·9	25·3	7·8	48·5	44·7	·294	3·4	0·6	87	537	79·7	41·1	1·2	5	4	10	12	4·5	7·7	85	21·61
Between the latitudes 50° and 51°	29·479	67·0	23·5	43·5	52·3	42·3	30·6	10·0	47·1	43·3	·285	3·2	0·4	87	541	79·8	36·0	1·5	7	5	7	12	5·6	7·1	70	15·61
Between the latitudes 51° and 52°	29·474	68·1	17·5	50·6	49·8	38·6	37·5	11·2	44·0	41·0	·261	3·1	0·4	90	541	75·9	34·3	1·3	6	6	8	11	1·6	6·9	85	13·61
Between the latitudes 52° and 53°	29·450	68·2	18·4	49·8	49·1	37·9	36·3	11·2	43·4	40·1	·253	2·9	0·4	88	544	67·6	34·2	1·0	5	6	9	10	3·4	7·1	64	11·47
Between the latitudes 53° and 54°	29·471	67·9	18·2	49·7	47·9	38·1	33·7	9·8	43·1	39·4	·244	2·8	0·4	87	542	60·3	35·2	1·3	6	6	8	10	—	7·6	68	10·47
Between the latitudes 54° and 55°	29·419	69·4	16·5	52·9	47·3	36·5	43·3	10·8	41·9	38·3	·236	2·7	0·5	87	545	69·0	31·0	1·3	4	10	6	11	6·5	6·9	57	10·15
Mean for the Quarter, 50° to 55° — Year 1879	29·987	65·2	12·1	53·1	46·8	35·0	38·0	11·8	40·7	37·0	·226	2·6	0·4	86	556	66·4	30·5	1·0	9	8	5	9	3·2	6·6	53	4·—
" 1880	29·648	64·5	21·8	43·3	49·3	38·0	34·1	11·3	43·9	39·1	·241	2·8	0·5	86	548	68·9	33·1	1·3	7	6	6	12	3·4	6·6	80	15·—
" 1881	29·685	63·4	23·6	39·9	50·0	38·9	32·9	11·1	44·5	40·3	·255	2·9	0·5	86	547	72·3	33·5	1·4	4	7	9	11	3·7	6·4	50	7·—
" 1882	29·458	68·1	18·8	49·3	49·3	38·7	36·3	10·6	43·9	40·4	·256	2·9	0·4	88	545	70·5	34·2	1·3	6	7	7	11	4·3	7·2	85	15·—

METEOROLOGY OF ENGLAND,

DURING THE QUARTER ENDING MARCH 31, 1883.

REMARKS ON THE WEATHER DURING THE QUARTER ENDING MARCH 31ST, 1883.

By JAMES GLAISHER, Esq., F.R.S., *&c.*

The weather in January was warm, with frequent rain; the sky was mostly overcast. The atmospheric pressure was for a few days together above its average, then for a few days below; there were heavy storms from the 24th to the 28th days. Water was standing in all low places, and the land generally was saturated, and not workable.

The weather in February was mild throughout the month, with excessive rain during the first three weeks, causing heavy floods, and perfectly saturating the land. The atmospheric pressure was low during the first half of the month and high afterwards. The last week was fine and dry.

The weather in March from the 6th day was very cold throughout the month, with but little rain, but frequent falls of snow. The atmospheric pressure was above its average during the first week and afterwards below. The wind, which was frequently from the North-east and North-west, was dry and searching; under its influence the land dried rapidly enabling farming work to proceed satisfactorily.

The mean daily temperature of the air was above the average, with but few exceptions, from January 1st to March 5th, the average daily excess being 3°·6. From March 6th to the end of the quarter the weather was cold, the average daily deficiency of temperature being 6°·4.

The mean temperature of the air for January was 41°·2, being 4°·7 and 2°·8 above the averages of 112 years and 42 years respectively; it was 0°·8 higher than in 1882, 9°·6 higher than in 1881, and 8°·0 higher than in 1880. The following are the only instances back to 1771 when the mean temperature of January was as high as 41°·2:

In 1796	it was	45°·3	In 1852	it was	42°·0	In 1873	it was	42°·1
„ 1804	„	43°·2	„ 1853	„	42°·4	„ 1874	„	41°·7
„ 1834	„	44°·4	„ 1863	„	41°·8	„ 1875	„	43°·4
„ 1846	„	43°·7	„ 1866	„	42°·6	„ 1877	„	42°·7
„ 1851	„	42°·9	„ 1872	„	41°·3			

The mean temperature of the air for February was 42°·6, being 3°·9 and 3°·1 above the averages of 112 years and 42 years respectively; it was 0°·8, 3°·9, and 0°·8 higher than in 1882, 1881, and 1880 respectively. Back to 1771 there have only been 13 instances when the mean temperature of February was as high as 42°·6, viz.:

In 1794	it was	44°·7	In 1848	it was	43°·4	In 1868	it was	43°·0
„ 1809	„	44°·1	„ 1849	„	43°·2	„ 1869	„	45°·3
„ 1817	„	42°·6	„ 1850	„	44°·7	„ 1872	„	44°·8
„ 1822	„	43°·3	„ 1867	„	44°·7	„ 1877	„	42°·6
„ 1846	„	43°·9						

The mean temperature of the air for March was 36°·1, being 5°·0 and 5°·7 below the averages of 112 years and 42 years respectively; it was 9°·9, 6°·5, and 8°·2 lower than in 1882, 1881, and 1880, respectively. Back to 1771 there have only been six instances as cold as 36°·1, viz.:

In 1785	it was	33°·9	In 1789	it was	34°·4	In 1837	it was	35°·8
„ 1786	„	34°·2	„ 1814	„	35°·1	„ 1845	„	35°·2

The mean temperature of January and February was high, being 41°·9. Back to 1771 there are only seven instances of so high a mean temperature for these two months, viz.:

In 1796	it was	42°·5	In 1863	it was	42°·0	In 1872	it was	43°·0
„ 1834	„	42°·3	„ 1869	„	43°·2	„ 1877	„	43°·1
„ 1846	„	43°·8						

The mean temperature for the quarter was 40°·0, being 1°·2 above the average of 112 years and 0°·1 above the average of 42 years.

The mean high day temperature of the air in January was 45°·4, being 2°·5 above the average of 42 years; in February it was 48°·5, being 3°·0 above the average, and in March was 44°·1, being 6°·0 below the average.

The mean low night temperature of the air was in January, 36°·3, being 2°·8 above the average of 42 years; in February it was 37°·2, being 2°·8 above its average; and in March it was 29°·3, being 6°·0 below the average. Therefore both the high day temperatures and low night temperatures in January and February were high, and in March were very low.

The mean daily range of temperature in January was 0°·5 smaller than the average, in February was 0°·2 greater than the average, and in March was 0°·1 greater than the average.

The mean temperature of the air in January was 1°·1 higher than in December, in February was 1°·4 higher than in January, and in March was 6°·5 lower than in February. (From the preceding 42 years observations the decrease of temperature from December to January is 1°·5; the increase of temperature from January to February is 1°·1, and from February to March is 2°·3.)

From December to January there was an increase of temperature at stations south of 51° of 0°·7, between 51° and 52° of 1°·5, between 52° and 53° of 1°·6, between 53° and 54° of 1°·9, and between 54° and 55° of 2°·8.

From January to February there was an increase of temperature south of 51° of 0°·1, between 51° and 52° of 2°·0, between 52° and 53° of 1°·7, between 53° and 54° of 2°·6, and between 54° and 55° of 2°·0.

From February to March there was a decrease of temperature south of 51° of 5°·9, between 51° and 52° of 6°·5, between 52° and 53° of 6°·9, between 53° and 54° of 6°·6, and between 54° and 55° of 6°·1.

1883. Months.	Temperature of Air. Mean.	Air. Diff. from average of 112 years.	Air. Diff. from average of 42 years.	Temperature of Evaporation. Mean.	Evaporation. Diff. from average of 42 years.	Temperature of Dew Point. Mean.	Dew Point. Diff. from average of 42 years.	Air—Daily Range. Mean.	Air—Daily Range. Diff. from average of 42 years.	Elastic Force of Vapour. Mean.	Elastic Force of Vapour. Diff. from average of 42 years.	Weight of Vapour in a Cubic Foot of Air. Mean.	Weight of Vapour in a Cubic Foot of Air. Diff. from average of 42 years.
	°	°	°	°	°	°	°	°	°	in.	in.	grs.	gr.
Jan. -	41·2	+4·7	+2·8	39·6	+2·8	37·6	+2·9	9·1	−0·5	·225	+0·026	2·6	+0·2
Feb. -	42·6	+3·9	+3·1	40·9	+3·2	38·8	+3·5	11·3	+0·2	·236	+0·026	2·7	+0·4
Mar. -	36·1	−5·0	−5·7	33·2	−6·2	29·2	−7·0	14·8	+0·1	·161	−0·056	1·9	−0·7
Means -	40·0	+1·2	+0·1	37·9	−0·1	35·2	−0·2	11·7	−0·1	·207	+0·001	2·4	0·0

1883. Months.	Degree of Humidity. Mean.	Degree of Humidity. Diff. from average of 42 years.	Reading of Barometer. Mean.	Reading of Barometer. Diff. from average of 42 years.	Weight of a Cubic Foot of Air. Mean.	Weight of a Cubic Foot of Air. Diff. from average of 42 years.	Rain. Amount.	Rain. Diff. from average of 67 years.	Daily Horizontal movement of the Air.	Reading of Thermometer on Grass. Number of Nights it was At or below 30°.	Between 30° and 40°.	Above 40°.	Lowest Reading at Night.	Highest Reading at Night.
			in.	in.	grs.	grs.	in.	in.	Miles.				°	°
Jan. -	87	0	29·735	−0·017	550	− 4	1·69	−0·20	339	17	13	1	21·9	49·5
Feb. -	86	+ 1	29·904	+0·115	551	− 2	2·89	+1·32	349	7	20	1	25·7	41·1
Mar. -	76	− 5	29·749	0·000	556	+ 6	0·78	−0·77	337	24	7	0	14·8	37·9
Means -	83	+ 1	29·796	+0·033	552	0	Sum 5·36	Sum +0·35	Mean 342	Sum 48	Sum 40	Sum 2	Lowest 14·8	Highest 49·5

NOTE.—In reading this table it will be borne in mind that the plus sign (+) signifies *above* the average, and that the minus sign (−) signifies *below* the average.

The average duration of the different directions of the wind referred to eight points of the compass, and the duration of each direction in each month in the quarter, were as follows:—

Direction of Wind.	January. 1883.	January. Average.	January. Departure from Average.	February. 1883.	February. Average.	February. Departure from Average.	March. 1883.	March. Average.	March. Departure from Average.
	d.	d.	d.	d.	d.	d.	d.	d.	d.
N.W.	1½	1½	+ ¼	1¼	2	− ¼	9½	2¾	+6¾
N.	¼	3	− 2¾	0	3	−3	2½	3¾	−1¼
N.E.	2	3¼	− 1¼	¼	3¼	−1	8¼	4	+4¼
E.	10¾	[illegible]	+10	1	2	−1	2¾	2½	+ ¼
S.E.	3	2¼	+ ¾	7¼	1¼	+6¼	1½	2	− ½
S.	3	4¼	− 1¼	5	3	+2	0	2½	−2½
S.W.	9½	9½	− ¼	8½	8	+2½	1¾	7¾	−6
W.	¾	3¼	− 2¾	3¼	2¾	+1	4¼	3¼	+1¼
Calm.	0	2¼	− 2¼	0	2½	−2½	0	2½	−2½

The plus sign (+) denotes excesses over averages; the largest numbers affected with this sign in the month of January are opposite to E. and S.E.; in February to S.E. and S.; and in March to N.W. and N.E.

The minus sign (−) denotes deficiencies below averages. In January the largest numbers are opposite to W. and N.; in February to N., N.E., and E.; and in March to S.W. and S.

About London the mean daily pressure of the atmosphere was below its average for the first two days, the deficiency being 0·24 in.; from the 3rd to the 8th it was above its average, the average daily excess being 0·34 in.; from the 9th to the 16th it was below, the average deficiency for these eight days being 0·33 in.; then from the 17th till the 24th it was above its average (the 22nd and 23rd being as much as 0·66 in. and 0·67 in. respectively above), and the daily excess was 0·40; from January 25th to February 3rd, there was a deficiency of 0·38 in. daily, this was followed by three days above the daily excess being 0·19 in.; from the 7th to the 14th there was a deficiency of 0·23 in. daily; from February 15th to March 6th there was a daily deficiency of 0·44 in.; and from this date to the end of the quarter there was a mean daily deficiency of 0·19 inch.

The mean reading of the barometer for the month of January at the height of 160 feet above the sea was 29·735 ins., being 0·017 in. below the average of 42 years; 0·450 in. below that of 1882; and 0·025 in. below that of 1881.

The mean reading of the barometer for the month of February was 29·904 ins., being 0·115 in. above the average of 42 years, 0·147 in. below that of 1882, and 0·243 in. above that of 1881.

The mean reading of the barometer for the month of March was 29·749 ins., being the same as the average of 42 years, 0·094 in. below that of 1882, and 0·021 in. above that of 1881.

(From the 42 preceding years observations the mean pressure in January is 0·036 in. less than in December; that in February is 0·037 in. above that in January, and that in March is 0·040 in. below that in February.)

From December to January there was an increase of pressure at stations south of 51° of 0·021 in.; between 51° and 52° of 0·22 in.; and between 52° and 53° of 0·23 in.; and between 53° and 54° of 0·20 in.; and north of 54° of 0·16 in.

From January to February there was a decrease of pressure upon extreme northern stations of 0·18 in. to extreme southern stations of 0·13 in.

From February to March between the stations Somerleyton and Truro, there was a deficiency of 0·13 in., from Wolverhampton to Hull there was a deficiency of 0·05 in., from Stonyhurst to Bradford of 0·01 in., and from Lancaster to Carlisle a deficiency of 0·04 in.

Thunderstorms occurred in January on the 27th at Truro; and on the 29th at Cambridge.

In February, on the 1st at Guernsey, Truro, Plymouth, and Torquay; and on the 2nd at Totnes.

Thunder was heard but lightning was not seen in February, on the 11th at Bradford; on the 13th at Carlisle; on the 15th at Stonyhurst; and on the 18th at Carlisle; and in March, on the 21st at Guernsey.

Lightning was seen but thunder was not heard in January, on the 10th at Carlisle, and on the 30th at Cambridge; and in March, on the 25th at Llandudno.

Solar halos were seen on January 14th and 15th at Oxford; on the 15th at Cardington; on the 23rd and 28th at Torquay; on the 28th at Oxford; and on the 31st at Oxford and Bermerside.

In February, on the 1st at Torquay; on the 5th at Guernsey and Oxford; on the 16th at Torquay, Oxford, and Stonyhurst; on the 18th and 19th at Torquay.

In March, on the 14th at Torquay; on the 16th at Torquay and Oxford; on the 19th at Torquay; on the 26th, 28th, and 29th at Halifax; and on the 31st at Guernsey.

Lunar halos were seen on the 13th at Lowestoft; on the 15th at Cambridge; on the 17th at Wolverhampton and Halifax; on the 18th and 19th at Oxford and Halifax; on the 20th at Wolverhampton; and on the 27th at Oxford.

In February on the 12th at Oxford and Cambridge; on the 14th at Oxford; on the 15th at Oxford, Cambridge, and Lowestoft; on the 16th at Oxford and Rugby; on the 17th at Oxford; and on the 19th at Salisbury, Barnet, Wolverhampton, Leicester, and Stonyhurst.

In March, on the 19th at Torquay; and on the 26th at Bermerside.

Aurora borealis was seen in February, on the 12th at Hull; and on the 24th at Cambridge.

In March on the 3rd and 10th at Oxford.

Snow fell in January on the 8th at Royston; on the 9th at Marlborough, Oxford, and Burslem; on the 15th at Cambridge; on the 23rd at Carlisle; on the 24th at Salisbury, Whitchurch, Barnet, Royston, Cambridge, and Wolverhampton; on the 25th at Cardington, Somerleyton, Wolverhampton, Bolton, Bermerside, and Bradford; on the 26th at Totnes, Torquay, Royston, Bolton, Bermerside, Hull, Bradford, and Leeds; on the 27th at Marlborough, Burslem, Royston, Cardington, Rugby, Lowestoft, Wolverhampton, Bermerside, Bradford, Leeds, and Lancaster; on the 28th at Bermerside and Carlisle; on the 29th at Burslem, Llandudno, Bolton, Halifax, and Carlisle: on the 30th at Torquay, Marlborough, Barnet, Burslem, Bermerside, and Bradford; on the 31st at Torquay.

In February, on the 1st at Wolverhampton, Llandudno, and Bolton; on the 2nd at Royston; on the 7th at Bradford; on the 11th at Oxford and Bradford; and on the 13th at Carlisle.

In March snow fell at every station on about five or six, at some places it fell on 12 days, falling all over the country at nearly the same time.

Hail fell on the 2nd January at Torquay and Salisbury; on the 9th at Guernsey; on the 23rd at Bolton; on the 24th at Truro, Salisbury, Royston, Leicester, and Bolton; on the 25th Salisbury and Marlborough; on the 26th at Guernsey, Totnes, Torquay, Ventnor, Osborne, Salisbury, Rugby, Lowestoft, Llandudo, Bermerside, and Carlisle; on the 27th at Guernsey, Salisbury, Oxford, Llandudno, and Bermerside; on the 28th at Bermerside; on the 30th at Plymouth, Marlborough, Burslem, Cardington, and Llandudno; and on the 31st at Totnes and Torquay.

In February, on the 1st at Torquay; on the 2nd at Truro; on the 3rd at Guernsey, Torquay, and Oxford; on the 11th at Guernsey, Oxford, Royston, and Stonyhurst; on the 12th at Guernsey, Torquay, and Stonyhurst; on the 13th at Torquay, Osborne, Blackheath, Llandudno, and Carlisle; on the 14th at Oxford; on the 15th at Guernsey, Blackheath, Oxford, Cambridge, Rugby, and Llandudno.

In March, on the 6th at Ventnor, Blackheath, Oxford, Royston, Lowestoft, Somerleyton, and Hull; on the 7th at Lowestoft, Somerleyton, and Hull; on the 8th, 9th, 10th, and 11th at Lowestoft and Somerleyton; on the 14th at Guernsey; on the 15th at Stockton; on the 16th at Llandudno, Bolton, and Stonyhurst; on the 17th at Guernsey, Truro, Plymouth, Torquay, Salisbury, Oxford, and Llandudno; on the 22nd at Hull; on the 24th at Bedford, Hull, and Stonyhurst; on the 25th at Bolton; on the 26th at Truro and Llandudno; on the 27th at Plymouth, Royston, Llandudno, and Hull.

MONTHLY METEOROLOGICAL TABLE FOR THE QUARTER ENDING MARCH 31st, 1883.

The Observations have been reduced to Mean values by Glaisher's Barometrical and Diurnal Range Tables, and the Hygrometrical results have been deduced from the sixth edition of his Hygrometrical Tables.

Names of Stations and Observers.	Height of Station above Sea Level.	Year 1883. Months.	Pressure of Atmosphere in Month. Mean.	Pressure of Atmosphere in Month. Range.	Temperature of Air in Month. Highest.	Temperature of Air in Month. Lowest.	Temperature of Air in Month. Range.	Temperature of Air in Month. Mean of all Highest.	Temperature of Air in Month. Mean of all Lowest.	Temperature of Air in Month. Mean Daily Range.	Mean Temperature. Air.	Mean Temperature. Dew Point.	Vapour. Elastic Force.	Vapour. In a cubic foot of Air. Mean.	Vapour. In a cubic foot of Air. Short of Saturation.	Mean Degree of Humidity. Sat. = 100.	Mean Weight of a cubic foot of Air.	Mean Reading of Thermometer. Maximum in Rays of Sun.	Mean Reading of Thermometer. Minimum on Grass.	Wind. Estimated Strength.	Wind. Relative Proportion of N.	Wind. Relative Proportion of E.	Wind. Relative Proportion of S.	Wind. Relative Proportion of W.	Mean Amount of Ozone.	Mean Amount of Cloud.	Rain. Number of Days it fell.	Rain. Amount collected.
	feet.		in.	in.	°	°	°	°	°	°	°	°	in.	grs.	gr.		grs.	°	°									
GUERNSEY, Adolphus Collenette, Esq., F.M.S.	270	Jan.	29·629	1·489	55·0	32·2	22·8	48·0	40·2	7·8	43·9	41·5	·263	3·0	0·3	91	545	72·9	36·6	1·3	1	9	13	8	4·2	7·3	21	2·99
		Feb.	29·821	2·030	52·3	34·8	17·5	48·9	40·1	8·8	44·5	41·4	·261	3·0	0·3	89	548	88·1	36·4	1·2	3	3	10	12	4·2	6·8	20	4·33
		Mar.	29·618	1·268	52·2	27·9	24·3	44·2	34·7	9·5	38·7	33·3	·193	2·3	0·5	82	551	92·1	31·2	1·0	15	6	2	8	3·3	5·5	17	2·89
TRURO (Cornwall), C. Barham, Esq., M.D., F.M.S.	43	Jan.	29·804	1·417	56·0	28·0	28·0	51·0	40·5	10·5	45·6	41·5	·283	3·0	0·6	86	546	—	—	2·8	1	9	9	12	—	7·7	19	3·86
		Feb.	29·999	2·106	56·0	28·0	28·0	52·0	38·5	13·5	44·2	41·8	·265	3·0	0·3	91	551	—	—	2·4	3	2	9	14	—	7·5	18	6·79
		Mar.	29·918	1·356	57·0	21·0	36·0	47·7	32·1	15·6	38·7	34·5	·200	2·3	0·4	86	557	—	—	2·6	12	9	2	8	—	6·2	13	2·56
PLYMOUTH (Devon), J. Merrifield, Esq., LL.D., F.R.A.S., F.M.S.	69	Jan.	29·826	1·425	54·2	30·8	23·4	49·5	40·0	9·5	44·6	43·1	·279	3·2	0·1	95	548	—	—	1·7	2	11	9	9	—	7·4	23	3·21
		Feb.	29·999	2·145	56·0	31·6	24·4	50·3	37·9	12·4	44·2	41·6	·263	3·0	0·3	91	551	—	—	1·4	5	3	11	9	—	7·2	20	4·44
		Mar.	29·905	1·359	57·6	24·5	33·1	46·6	32·4	14·2	39·0	33·7	·194	2·2	0·6	82	556	—	—	1·5	12	11	2	6	—	4·8	11	1·17
TOTNES (Devon), T. H. Edmonds, Esq.	107	Jan.	29·821	1·415	55·1	26·5	28·6	49·7	38·9	10·8	44·4	41·2	·260	2·6	0·4	89	548	—	—	4·1	3	3	9	11	—	7·6	25	5·92
		Feb.	30·009	2·110	56·8	25·4	31·4	51·5	37·0	14·5	44·3	40·2	·250	2·8	0·5	85	552	—	—	2·5	8	2	10	13	—	6·1	19	7·67
		Mar.	29·895	1·365	57·5	18·2	39·3	47·0	29·5	17·5	39·0	29·7	·164	1·9	0·9	70	556	—	—	2·5	19	7	1	4	—	4·2	12	1·86
TORQUAY, Babbacombe (Devon), Edwin E. Glyde, Esq., F.M.S.	305	Jan.	29·548	1·405	55·9	31·8	24·1	49·0	39·3	9·7	44·2	40·7	·255	2·9	0·4	88	548	75·4	32·8	2·0	2	8	10	11	4·5	7·2	22	3·86
		Feb.	29·733	2·087	57·6	29·2	28·4	50·6	37·7	12·9	44·2	40·2	·250	2·8	0·5	85	552	91·3	29·1	1·7	1	2	11	14	5·9	6·6	18	5·68
		Mar.	29·610	1·362	55·9	23·3	32·6	45·8	31·7	14·1	38·4	31·4	·177	2·1	0·7	76	551	97·5	23·6	1·6	12	9	2	8	4·3	4·5	10	1·37
VENTNOR, (Isle of Wight) (Royal National Hospital for Consumption), Hartley Sagar, Esq.	80	Jan.	29·842	1·404	52·5	34·3	18·2	48·1	41·3	6·8	44·8	30·5	·252	2·7	0·5	86	548	—	—	1·3	3	9	8	11	3·3	6·8	21	2·27
		Feb.	29·997	1·951	54·4	34·8	19·6	50·5	41·0	9·5	45·0	4 ·8	·275	3·1	0·3	92	551	—	—	1·9	4	2	10	12	6·8	6·7	19	3·42
		Mar.	29·883	1·402	55·3	24·9	30·4	46·2	33·5	12·7	38·7	32·3	·182	2·1	0·7	69	555	—	—	1·4	12	11	3	5	6·0	4·6	10	0·66
		1882																										
EASTBOURNE, (Sussex), Miss W. L. Hall.	12	Oct.	29·750	1·352	66·5	24·0	32·5	61·3	47·7	13·6	53·2	50·4	·364	3·7	0·5	91	537	87·7	43·6	0·3	9	3	8	11	1·9	—	23	7·50
		Nov.	29·653	1·096	59·0	26·3	32·7	49·9	41·0	8·9	45·1	40·2	·248	2·5	0·5	83	544	75·2	38·0	0·3	11	2	2	15	3·1	—	22	4·55
		Dec.	29·626	1·292	53·0	21·9	31·1	45·2	37·0	8·2	41·3	39·0	·244	3·0	0·1	94	548	52·2	29·0	0·2	11	1	8	11	1·9	—	21	4·44
		1883.																										
OSBORNE (Isle of Wight), J. R. Mann, Esq.	172	Jan.	29·715	1·320	53·5	30·1	23·4	46·7	37·4	9 3	41·9	39·9	·246	2·9	0·2	93	549	68·8	35·7	0·3	4	7	12	8	—	7·0	26	2·82
		Feb.	29·887	1·948	54·1	32·3	21·8	49·6	37·6	12·0	43·3	40·5	·252	2·9	0·3	89	551	82·8	35·6	0·3	1	2	16	9	—	6·7	18	3·95
		Mar.	29·737	1·412	58·0	22·2	35·8	46·6	30·4	16·2	37·3	30·3	·170	1·9	0·7	76	555	99·4	27·9	0·2	13	8	3	7	—	4·3	9	0·63
		1882.																										
		Oct.	29·698	1·638	64·5	35·7	28·8	57·4	46·0	11·4	51·8	47·2	·326	3·7	0·6	85	537	—	—	1·4	7	3	8	8	—	6·1	23	6·67
		Nov.	29·635	0·956	59·5	26·7	32·8	51·0	40·6	10·4	45·5	40·5	·252	2·9	0·6	83	543	—	—	1·2	9	3	2	17	—	5·3	21	3·68
SOUTHBOURNE, (near) Bournemouth (Hants), T. A. Compton, Esq., M.D., B.A., F.M.S.	95	Dec.	29·550	1·256	53·8	20·0	33·8	45·8	37·9	7·9	42·2	38·7	·237	2·7	0·4	87	546	—	—	1·2	10	6	5	10	—	7·0	24	2·50
		1883.																										
		Jan.	29·813	1·348	52·9	31·1	21·8	47·3	38·7	8·6	42·7	40·1	·248	2·8	0·2	90	550	—	—	1·4	5	7	10	9	—	6·7	21	2·46
		Feb.	29·964	2·026	54·0	28·7	25·3	49·1	39·1	10·0	44·0	40·7	·254	2·9	0·4	88	551	—	—	1·4	3	3	10	12	—	6·0	17	3·44
		Mar.	29·855	1·409	56·2	23·1	33·1	45·2	30·7	14·5	37·2	30·8	·172	2·0	0·7	77	557	—	—	1·3	20	4	2	5	—	3·3	9	0·73
SALISBURY (Wilton House), Wilts, Thomas Challis, Esq.	186	Jan.	29·680	1·464	54·5	24·0	30·5	47·4	33·1	14·3	40·7	38·5	·233	2·7	0·3	92	550	63·3	31·9	1·1	2	10	12	7	—	7·7	25	3·17
		Feb.	29·847	2·010	55·0	27·0	24·0	50·0	33·6	16·4	42·2	39·8	·245	2·8	0·3	92	551	78·6	30·9	1·2	5	1	13	9	—	7·0	21	5·10
		Mar.	29·727	1·406	58·0	18·0	40·0	46·6	26·3	20·3	36·2	32·5	·185	2·1	0·4	87	556	93·0	23·7	1·1	15	6	3	5	—	4·8	18	1·47

Names of Stations and Observers.	Height of Station above Sea Level.	Year 1883.	Pressure of Atmosphere in Month.		Temperature of Air in Month.						Mean Temperature.		Vapour.			Mean Degree of Humidity. Sat. = 100.	Mean Weight of a cubic foot of Air.	Mean Reading of Thermometer.		Wind.					Mean Amount of Ozone.	Mean Amount of Cloud.	Rain.	
								Mean					Elastic Force.	In a Cubic foot of Air.				Maximum in Rays of Sun.	Minimum on Grass.	Estimated Strength.	Relative Proportion of							
	Height of Station above Sea Level.	Months.	Mean.	Range.	Highest.	Lowest.	Range.	Of all Highest.	Of all Lowest.	Daily Range.	Air.	Dew Point.		Mean.	Short Saturation.						N.	E.	S.	W.			Number of Days it fell.	Amount collected.
	feet.		in.	in.	°	°	°	°	°	°	°	°	in.	grs.	gr.		grs	°	°									
BARNSTAPLE (Devon), William Knill, Esq.	43	Jan.	29·832	1·340	57·0	31·5	25·5	50·0	39·7	10·3	44·6	41·1	·258	2·9	0·2	88	549	—	—	1·3	3	7	14	7	—	5·3	18	3·60
		Feb.	29·958	2·130	55·0	30·5	24·5	51·1	40·3	10·8	45·6	42·0	·268	3·0	0·5	87	544	—	—	1·2	3	4	11	10	—	4·0	23	5·27
		Mar.	29·904	1·340	59·0	23·0	36·0	47·2	33·8	13·4	40·1	29·3	·162	1·9	1·0	64	555	—	—	1·2	13	10	2	6	—	2·6	10	0·98
BATH (Somerset), St. Gregory's College, Downside, Rev. T. J. Almond, O.S.B., F.M.S.	596	Jan.	29·233	1·332	53·4	28·1	25·3	48·0	35·7	9·3	40·8	37·9	·230	2·7	0·3	91	541	67·0	29·9	1·9	4	7	10	10	—	7·7	25	4·56
		Feb.	29·381	2·033	5·0	28·5	24·5	44·7	36·9	7·8	41·2	39·0	·237	2·8	0·3	92	543	85·9	31·2	1·5	3	3	11	11	—	6·7	19	5·40
		Mar.	29·270	1·394	52·5	18·1	34·4	42·7	28·4	14·3	35·3	30·7	·172	2·1	0·5	83	548	94·9	21·9	1·4	11	8	4	8	—	4·7	12	1·33
STRATHFIELD TURGISS (Hants) Rev. C. H. Griffith, M.A., F.M.S.	197	Jan.	29·689	1·484	54·3	25·8	28·5	46·3	35·4	10·9	40·9	37·8	·228	2·7	0·3	89	550	62·7	30·1	1·1	2	8	10	11	1·3	6·9	23	2·81
		Feb.	29·872	1·839	55·7	23·7	27·0	42·7	35·9	6·8	48·6	39·2	·241	2·7	0·3	85	550	84·1	30·3	1·1	1	3	9	15	1·8	6·8	16	4·09
		Mar.	29·728	1·426	56·1	13·8	42·3	45·4	23·1	17·3	36·1	32·4	·185	2·1	0·4	88	556	89·8	22·3	1·2	11	10	2	8	1·4	4·4	6	0·77
MARLBOROUGH (Wilts), Rev. Thomas A. Preston, M.A., F.M.S.	456	Jan.	29·370	1·336	53·2	28·3	24·9	44·6	36·1	8·5	40·3	37·5	·223	2·6	0·3	89	547	64·1	33·0	1·1	3	8	11	9	—	7·2	24	3·79
		Feb.	29·545	1·965	52·7	30·9	21·8	45·1	36·4	11·7	41·8	39·3	·258	2·7	0·5	90	546	81·4	34·3	1·1	4	8	12	9	—	7·3	19	5·30
		Mar.	29·417	1·400	55·2	18·5	36·7	43·1	27·6	15·5	34·8	29·3	·161	1·9	0·5	80	552	92·1	25·3	1·0	12	12	3	4	—	4·6	10	1·29
WHITCHURCH RECTORY (Oxon). (near Reading). Rev. J. Slatter, M.A., F.M.S.	150	Jan.	29·766	1·474	53·8	28·1	25·7	45·9	36·0	9·9	41·0	40·0	·2 8	2·9	0·2	97	551	—	—	1·1	4	7	12	8	—	7·3	22	2·85
		Feb.	29·910	1·876	54·5	29·6	24·9	47·7	35·3	12·4	42·2	41·2	·256	3·2	0·3	96	550	—	—	1·1	2	4	10	12	—	7·4	15	3·72
		Mar.	29·764	1·408	57·2	29·2	37·2	44·1	28·4	15·7	36·0	33·7	·195	2 2	0·3	92	557	—	—	—	12	11	8	5	—	4·0	16	1·05
BLACKHEATH (Kent), James Glaisher, Esq., F.R.S.	150	Jan.	29·736	1·467	54·9	29·2	24·8	45·3	37·0	8·3	41·1	37·7	·226	2·6	0·4	88	550	63·2	31·4	1·1	4	12	9	6	—	6·4	23	1·75
		Feb.	29·913	·875	53·5	31·9	21·6	47·7	37·6	10·1	42·7	38·3	·232	2 6	0·5	85	552	79·7	32·6	1·2	1	5	13	9	—	6·5	14	2·64
		Mar.	29·750	1·484	54·3	24·0	30·3	44·2	30·6	13·6	35·9	30·6	·172	2·0	0·5	81	557	89·5	25·4	1·2	11	9	1	10	—	5·8	10	0·73
ROYAL OBSERVATORY, Greenwich. W. H. M. Christie, M.A., F.R.S., Astronomer Royal.	159	Jan.	29·735	1·455	55·0	28·8	26·2	45·4	36·3	9·1	41·2	37·6	·225	2·6	0·4	87	550	61·1	31·5	—	—	—	—	—	3·3	7·2	19	1·69
		Feb.	29·904	1·878	55·2	30·9	24·3	48·5	37·2	11·3	42·6	38·8	·236	2·7	0·4	86	551	74·2	31·8	—	—	—	—	—	5·1	6·7	15	2·09
		Mar.	29·749	1·467	56·7	20·6	36·1	44·1	29·3	14·8	36·1	29·2	·161	1·9	0·6	76	556	89·2	25·0	—	—	—	—	—	2·4	5·6	14	0·78
CAMDEN SQUARE (London). G. J. Symons, Esq., F.R.S., F.M.S.	128	Jan.	29·767	1·460	55·3	28·8	26·5	46·3	36·9	9·4	41·6	37·7	·218	2·6	0·4	87	550	55·7	33·1	—	—	—	—	—	—	7·5	21	2·07
		Feb.	29·945	1·868	57·3	29·3	28·0	49·0	36·5	12·5	43·0	38·8	·226	2·7	0·5	85	552	68·1	35·2	—	4	2	9	13	—	6·3	14	3·62
		Mar.	29·794	1·472	57·0	22·4	34·6	44·9	30·4	14·5	36·8	32·0	·173	2·1	0·5	78	556	81·0	27·8	—	14	7	4	6	—	5·8	11	0·86
BARNET (Gas Works), T. H. Martin, Esq., C.E.	212	Jan.	29·480	1·592	55·5	20·8	34·7	45·2	34·1	11·1	40·1	37·1	·221	2·6	0·4	90	550	60·2	28·9	1·0	5	8	8	10	—	7·5	20	2 51
		Feb.	29·869	1·872	55·2	23 0	32·2	49·3	34·6	14·7	41·6	39·1	·259	2·8	0·3	92	552	68·7	29·1	0·9	:	2	6	17	—	6·9	15	3·58
		Mar.	29·724	1·453	54·9	17·7	37·2	44·2	23·0	16·2	33·3	31·0	·174	2·1	0·4	84	557	90·6	22·1	1·4	9	14	2	6	—	5·1	9	0·82
OXFORD (The Observatory), E. J. Stone, Esq., M.A., F.R.S.	210	Jan.	29·658	1·436	54·9	28·6	26·3	47·2	37·5	9·7	41·8	38·2	·231	2·7	0·4	88	548	73·4	33·1	1·1	1	10	12	8	1·1	6·8	23	2·52
		Feb.	29·835	1·970	54·4	30·7	23·7	49·3	38·8	10·5	43·8	40·3	·250	2·9	0·4	87	549	82·8	38·1	1·1	1	2	13	12	1·0	6·7	15	3·66
		Mar.	29·703	1·443	56·2	20·5	35·7	44·9	30·2	14·7	36·9	30·8	·173	2·0	0·6	79	555	91·7	24·9	3·0	13	8	3	7	1·5	5·1	12	1·03
BURSLEM, J. E. Worth, Esq., C.E.	556	Jan.	29·229	1·592	52·1	27·6	24·5	42·9	34·5	8·4	38·4	36·0	·212	2·5	0·3	92	544	—	—	0·6	2	10	14	5	—	6·5	22	3·47
		Feb.	29·397	1·898	54·7	30·0	24·7	46·2	36·2	10·0	40·7	38·7	·245	2·8	0·2	93	544	—	—	0·9	2	3	13	10	—	7·4	18	2·2.
		Mar.	29·328	1·498	52·0	19·8	32·4	41·4	29·6	12·8	34·3	30·3	·169	2·0	0·4	85	551	—	—	0·9	11	6	5	9	—	6·2	21	1·57
ROYSTON (Hertfordshire), Hale Wortham, Esq., F.R.A.S., F.M.S.	269	Jan.	29·026	1·492	54·3	28·0	26·3	44·8	35·7	9·1	40·0	34·5	·200	2·3	0·4	79	550	—	—	—	2	8	12	9	—	6·6	18	1·51
		Feb.	29·729	1·878	53·2	29·7	23·5	47·6	35·8	11·8	41·8	38·5	·252	2 8	0·2	88	549	—	—	—	4	5	9	10	—	5 6	19	3·26
		Mar.	29·656	1·477	54·4	16·8	37·6	42·9	23·5	14·4	34·7	30·6	·172	2·0	0·4	85	556	—	—	—	13	8	3	7	—	6·0	11	0·71
BEDFORD, Cardington, Mr. J. McLaren, Assistant to S. Whitbread, Esq., M.P.	105	Jan.	—	—	55·0	26·4	28·6	45·9	35·4	10·5	40·8	37·9	·227	2·3	0·3	90	—	48·5	32·5	1·7	2	9	10	10	—	7·5	19	1 60
		Feb.	30·081	1·436	57·6	28·6	29·0	49·7	36·0	13·7	42·3	39·5	·242	2·8	0·3	89	554	61·1	32·4	1·5	2	1	10	15	—	7·0	16	1·05
		Mar.	29·830	1·480	56·6	17·2	39·4	43·7	27·6	16·1	35·1	32·2	·184	2·2	0·4	92	560	72·4	24·5	2·0	15	8	1	7	—	5·5	11	0·90
CAMBRIDGE (Trinity College). J. W. L. Glaisher, Esq., M.A., F.R.S.	40	Jan.	29·856	1·568	56·0	24·8	31·2	45·6	25·9	9·7	40·9	37·5	·225	2·6	0·4	88	553	65·0	29·0	1·2	4	6	13	8	—	6·7	20	1·82
		Feb.	29·993	1·872	56·2	27·4	28·8	49·7	38·5	13·2	42·7	39·7	·244	2·8	0·3	88	553	84·7	29·0	1·3	2	3	10	13	—	6·8	17	2·44
		Mar.	29·868	1·526	57·9	15·0	42·9	44·8	28·0	16·3	35·2	33·1	·182	2·1	0·3	88	559	98·1	23·8	1·5	6	8	4	13	—	6·2	10	0·92

Names of Stations and Observers.	Height of Station above Sea Level.	Year 1883. Months.	Pressure of Atmosphere in Month. Mean.	Pressure of Atmosphere in Month. Range.	Temperature of Air in Month. Highest.	Lowest.	Range.	Mean Highest.	Mean Lowest.	Mean Daily Range.	Mean Temperature. Air.	Mean Temperature. Dew Point.	Vapour. Elastic Force.	Vapour. In a cubic foot of Air. Mean.	Vapour. In a cubic foot of Air. Short of Saturation.	Mean Degree of Humidity. Sat^{n}. = 100.	Mean Weight of a cubic foot of Air.	Mean Reading of Thermometer. Maximum in Rays of Sun.	Mean Reading of Thermometer. Minimum on Grass.	Wind. Estimated Strength.	Wind. Relative Proportion of N.	E.	S.	W.	Mean Amount of Ozone.	Mean Amount of Cloud.	Rain. Number of Days it fell.	Rain. Amount collected.
	feet.		in.	in.	°	°	°	°	°	°	°	°	in.	grs.	gr.		grs.	°	°								(in.
RUGBY (Warwickshire), Stockton, The Rectory, Rev. W. Tuckwell.	289	Jan.	29·434	1·300	54·8	26·0	28·8	45·1	33·4	11·7	39·8	37·1	·221	2·6	0·3	91	546	—	—	0·5	2	10	12	7	5·4	7·3	18	2·55
		Feb.	29·584	1·848	55·0	28·0	27·0	48·3	33·9	14·4	40·3	38·4	·236	2·7	0·2	92	548	—	—	0·6	2	4	16	6	6·8	6·4	16	3·13
		Mar.	29·516	1·530	56·0	10·0	46·0	42·7	26·3	16·4	35·0	27·4	·149	1·7	0·7	73	554	—	—	0·7	12	6	3	10	1·8	5·9	12	0·96
LOWESTOFT (Suffolk), S. H. Miller, Esq., F.R.A.S., F.M.S.	89	Jan.	29·795	1·094	54·4	29·6	24·8	44·2	36·1	8·1	40·4	36·9	·216	2·4	0·5	87	552	70·4	33·3	0·7	1	9	10	11	—	6·7	17	1·74
		Feb.	29·948	1·724	53·7	31·6	22·1	47·4	36·9	10·5	42·0	38·9	·231	2·7	0·4	89	553	79·6	32·3	0·5	2	2	9	15	—	5·9	15	2·17
		Mar.	29·793	1·564	54·0	22·6	31·4	41·3	30·9	10·4	35·9	30·6	·172	2·0	0·5	81	558	83·8	27·1	0·8	10	11	1	9	—	6·7	18	1·48
SOMERLEYTON (Suffolk), The Rectory, Rev. C. J. Steward, F.M.S.	50	Jan.	29·860	1·670	54·0	26·2	27·8	44·8	34·6	10·2	39·5	37·3	·222	2·3	0·2	92	554	—	—	1·0	2	9	10	10	5·3	6·0	18	1·85
		Feb.	29·998	1·638	55·2	28·0	27·2	48·3	34·8	13·5	41·1	38·7	·237	2·7	0·3	91	555	—	—	1·1	2	3	11	12	5·9	5·7	17	2·31
		Mar.	29·840	1·584	55·0	21·5	33·5	41·2	29·9	11·3	34·5	31·3	·176	2·2	0·4	86	560	—	—	1·1	9	12	2	8	6·4	5·8	20	1·64
WOLVERHAMPTON (Staffordshire), Wrottesley, E. Simpson, Esq.	500	Jan.	29·349	1·424	53·6	26·7	26·9	44·3	33·3	11·0	39·2	38·7	·195	2·3	0·5	81	540	—	—	—	1	10	12	8	—	8·1	18	3·22
		Feb.	29·483	1·592	54·7	27·8	26·9	46·7	34·2	12·5	40·9	38·5	·233	2·7	0·3	92	546	—	—	—	2	5	14	7	—	7·1	15	2·69
		Mar.	29·440	1·410	52·1	17·0	35·1	40·8	26·8	14·0	33·2	28·3	·155	1·8	0·4	81	554	—	—	—	9	9	4	9	—	6·3	9	1·35
LEICESTER (Town Museum), J. C. Smith, Esq.	288	Jan.	29·593	1·588	54·0	28·0	26·0	44·7	35·7	9·0	40·0	37·7	·226	2·6	0·3	92	549	59·3	32·2	0·9	2	6	13	10	—	7·3	22	2·81
		Feb.	29·741	1·862	57·0	31·5	25·5	48·1	36·9	11·2	42·4	38·5	·233	2·7	0·3	86	549	77·7	32·3	0·8	1	2	12	13	—	5·6	20	3·06
		Mar.	29·663	1·472	55·0	16·0	39·0	43·0	28·8	14·2	35·3	30·2	·168	1·9	0·5	81	557	82·8	23·1	0·7	13	7	4	7	—	4·6	14	1·10
NOTTINGHAM (Notts), M.O. Tarbotton, Esq., C.E., F.G.S., F.M.S.	183	Jan.	29·633	1·650	53·8	26·5	27·3	44·8	34·7	10·1	39·7	36·9	·220	2·6	0·3	90	550	53·5	32·5	0·4	1	12	10	8	1·8	8·6	15	2·13
		Feb.	29·784	1·854	58·0	28·9	29·1	47·9	36·1	11·8	42·0	39·3	·241	2·8	0·3	91	550	69·7	37·9	0·4	1	3	15	9	2·0	7·1	20	2·76
		Mar.	29·733	1·508	55·6	15·0	40·6	42·9	27·8	15·1	34·9	29·9	·165	2·0	0·4	81	557	77·6	27·5	0·3	9	8	5	9	1·4	6·3	19	1·07
HOLKHAM (Norfolk), John Davidson, Esq., Assistant to the Earl of Leicester.	89	Jan.	29·810	1·730	54·6	22·7	31·9	44·4	31·8	12·6	38·6	36·0	·209	2·7	0·2	91	555	53·9	27·4	1·5	1	7	19	4	—	6·9	12	2·04
		Feb.	29·972	1·776	54·4	26·6	27·8	46·9	33·4	13·5	40·9	38·9	·256	2·8	0·2	93	555	77·4	28·3	1·9	3	2	18	5	—	5·7	14	2·72
		Mar.	29·803	1·578	51·7	16·4	35·3	40·9	27·5	13·4	34·2	30·9	·174	2·1	0·2	87	561	88·3	24·3	1·7	12	9	6	5	—	6·8	11	1·52
LLANDUDNO (Carnarvonshire), James Nicol, Esq., M.D.	197	Jan.	29·679	1·680	54·0	30·2	23·8	46·4	37·2	9·2	42·2	37·3	·228	2·5	0·6	79	548	—	—	1·2	0	5	12	14	—	6·5	18	2·53
		Feb.	29·833	2·020	54·8	32·2	22·6	48·4	39·4	9·0	44·2	39·0	·238	2·8	0·5	82	549	—	—	1·3	0	1	10	17	—	6·7	18	2·79
		Mar.	29·850	1·680	52·8	26·0	26·8	43·0	32·7	10·3	37·9	33·9	·195	2·3	0·4	86	556	—	—	1·2	7	9	4	11	—	6·5	13	1·73
LIVERPOOL, The Observatory, John Hartnup, Esq., F.R.A.S.	197	1882. Oct.	29·591	1·404	67·7	35·4	32·3	54·9	45·6	9·3	48·9	46·4	·316	3·7	0·3	92	538	—	—	—	4	16	7	4	—	7·3	18	2·53
		Nov.	29·404	1·088	58·0	30·3	27·7	47·8	38·8	9·0	43·4	36·2	·213	2·5	0·6	76	542	—	—	—	4	7	4	15	—	6·6	26	4·82
		Dec.	29·390	1·241	58·6	17·2	56·6	42·0	35·2	6·8	38·6	36·8	·217	2·5	0·2	92	547	—	—	—	6	14	4	7	—	8·1	19	3·58
		1883. Jan.	29·581	1·602	56·0	31·8	24·2	44·8	36·8	8·0	40·5	36·6	·217	2·6	0·4	86	548	—	—	—	0	14	7	10	—	7·3	23	3·05
		Feb.	29·730	1·978	55·7	31·4	24·3	47·2	38·7	8·5	42·5	38·5	·234	2·7	0·5	84	549	—	—	—	0	7	9	13	—	6·4	17	1·45
		Mar.	29·743	1·583	54·2	26·4	27·8	42·3	32·5	9·8	36·6	30·2	·168	1·9	0·7	86	556	—	—	—	11	10	2	8	—	5·2	13	1·04
BOLTON, Sharples (Lancashire), Rev. T. Mackereth, F.R.A.S., F.M.S.	500	Jan.	29·263	1·606	52·4	24·7	27·7	42·6	33·3	9·3	38·4	36·5	·216	2·6	0·2	91	544	44·1	27·2	2·3	2	9	12	8	2·1	7·6	23	6·96
		Feb.	29·418	1·904	52·5	26·9	25·6	46·3	35·3	11·0	40·9	37·3	·228	2·6	0·4	87	545	51·7	28·5	1·9	2	3	13	10	2·2	8·0	21	3·28
		Mar.	29·393	1·530	55·4	19·0	36·4	41·5	28·1	13·4	34·6	29·9	·165	1·9	0·4	82	551	55·1	22·3	1·7	9	8	6	8	3·6	5·4	15	1·40
HALIFAX, Bermerside Observatory (Yorkshire), E. J. Crossley, Esq., F.R.A.S.	580	Jan.	29·810	1·662	51·0	24·0	27·0	40·8	33·2	7·6	37·1	35·0	·203	2·2	0·2	92	547	53·6	31·4	0·5	1	11	9	10	—	7·6	19	6·41
		Feb.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
		Mar.	29·397	1·536	57·0	14·0	43·0	42·6	27·8	14·8	34·1	28·6	·157	1·8	0·5	79	552	78·3	25·2	0·6	8	8	6	9	—	5·6	7	0·96
HULL (Yorkshire), The People's Park, Mr. E. Peak.	12	Jan.	29·847	1·876	54·0	24·0	30·0	43·8	33·2	10·6	39·2	35·3	·207	2·4	0·4	86	555	48·9	31·8	2·0	1	6	18	6	—	6·1	19	2·48
		Feb.	29·992	1·712	56·0	26·0	30·0	48·2	35·1	13·1	42·8	37·9	·237	2·6	0·6	83	553	61·8	34·1	1·7	1	6	15	6	—	5·7	16	2·91
		Mar.	29·914	1·524	54·0	10·0	44·0	43·5	27·7	15·8	36·0	32·0	·186	2·1	0·4	87	559	67·2	26·2	1·8	10	7	9	5	—	3·8	18	16·3
STONYHURST (Lancashire), Rev. S. J. Perry, F.R.S., F.M.S., F.R.A.S.	362	Jan.	29·409	1·644	54·0	22·0	32·0	43·8	33·4	9·9	38·3	34·6	·201	2·3	0·4	86	548	60·6	31·9	—	1	10	8	12	—	8·4	23	5·53
		Feb.	29·573	1·894	52·6	19·0	33·6	47·3	36·4	10·9	41·5	37·9	·229	2·6	0·8	85	548	82·4	34·1	—	1	5	10	12	—	8·4	20	2·97
		Mar.	29·564	1·472	55·2	17·8	37·4	43·7	26·8	17·4	34·5	29·4	·168	2·0	0·4	81	555	95·6	26 2	—	12	9	2	8	—	6·4	11	1·63

Names of Stations and Observers.	Height of Station above Sea Level.	Year 1883.	Pressure of Atmosphere in Month.		Temperature of Air in Month.						Mean Temperature.		Vapour.			Mean Degree of Humidity. Sat. = 100.	Mean Weight of a cubic foot of Air.	Mean Reading of Thermometer.		Wind.					Mean Amount of Ozone.	Mean Amount of Cloud.	Rain.	
								Mean						In a cubic foot of Air.						Relative Proportion of							
		Months.	Mean.	Range.	Highest.	Lowest.	Range.	Of all Highest.	Of all Lowest.	Daily Range.	Air.	Dew Point.	Elastic Force.	Mean.	Short of Saturation.			Maximum in Rays of Sun.	Minimum on Grass.	Estimated Strength.	N.	E.	S.	W.			Number of Days it fell.	Amount collected.
	feet.		in.	in.	°	°	°	°	°	°	°	°	in.	grs.	gr.		grs.	°	°								in.	
BRADFORD (Yorkshire), J. McLandsborough, Esq., C.E., F.G.S.	366	Jan.	29·395	1·720	54·1	26·6	27·5	48·8	35·7	8·1	39·8	36·3	·215	2·5	0·4	88	543	51·3	—	1·0	4	4	10	13	—	7·5	22	5·00
		Feb.	29·557	1·832	54·0	27·8	26·2	46·2	38·0	8·2	42·0	37·5	·245	2·6	0·5	85	546	56·6	—	1·0	2	3	11	12	—	7·0	16	1·52
		Mar.	29·539	1·524	54·4	19·8	34·6	41·6	29·9	11·7	34·9	31·0	·173	2·0	0·4	85	554	60·2	—	1·0	9	9	4	9	—	6·3	13	0·89
LEEDS (Yorkshire), The Philosophical Hall, Henry Crowther, Esq.	137	Jan.	29·662	1·722	56·0	26·0	30·0	44·8	36·1	8·7	41·0	37·2	·221	2·4	0·4	86	549	—	—	1·3	2	9	10	10	—	8·2	22	3·75
		Feb.	29·802	1·840	57·0	32·0	25·0	48·8	38·8	10·0	43·6	40·1	·348	2·8	0·4	87	549	—	—	1·2	2	4	8	14	—	7·2	14	1·99
		Mar.	29·788	1·533	58·0	20·0	38·0	42·8	30·3	12·5	36·2	30·7	·175	2·0	0·5	81	557	—	—	1·2	10	6	8	12	—	6·0	9	0·52
LANCASTER (Southfields), William Roper, Esq.	114	Jan.	29·701	1·608	53·0	25·0	28·0	45·0	35·4	9·6	40·3	37·1	·221	2·6	0·2	89	551	—	—	—	—	—	—	—	—	—	16	6·05
		Feb.	29·776	1·830	52·0	26·0	26·0	46·5	38·5	10·0	42·0	37·3	·223	2·6	0·5	84	550	—	—	—	—	—	—	—	—	—	21	3·05
		Mar.	29·794	1·502	56·0	20·0	36·0	43·6	28·8	14·8	35·6	30·8	·175	2·0	0·4	82	558	—	—	—	—	—	—	—	—	—	10	1·04
SILLOTH (Cumberland), "The Rectory," Rev. F. Redford, M.A., F.R.A.S., F.M.S.	28	Jan.	29·719	1·800	50·1	27·0	23·1	43·4	35·8	7·6	39·4	36·1	·213	2·5	0·4	89	552	68·4	32·6	1·8	2	12	8	9	8·8	6·5	19	3·76
		Feb.	29·854	1·846	52·0	28·0	24·0	46·2	37·2	9·0	41·9	37·8	·228	2·6	0·4	86	551	81·1	34·4	2·0	1	3	11	13	7·7	5·8	20	1·74
		Mar.	29·917	1·738	56·0	23·3	32·7	43·8	30·5	13·3	36·4	31·4	·179	1·9	0·7	75	569	93·5	28·2	1·5	13	8	3	7	5·4	4·8	7	0·72
CARLISLE, Spital (Cumberland), Isaac Cartmel, Esq., F.M.S.	114	Jan.	29·630	1·706	59·3	23·3	36·0	45·0	33·4	11·6	39·3	35·4	·208	2·4	0·2	85	550	53·2	26·1	1·1	2	18	6	10	8·8	7·7	13	3·38
		Feb.	29·772	1·802	58·2	25·8	32·4	47·1	36·0	11·1	41·7	39·3	·241	2·8	0·2	92	550	67·0	29·0	1·4	1	6	11	10	4·3	8·0	15	1·88
		Mar.	29·805	1·680	55·7	13·7	42·0	44·3	27·3	17·0	35·0	30·1	·166	1·9	0·5	81	559	76·6	19·3	0·9	5	8	5	13	3·4	6·6	7	1·42

Second Rain-gauges are placed—

			January.		February.		March.		Total in Quarter.
At Oxford, at the height of	22	feet *above the ground;* the amount collected was	2·47	inches.	3·57	inches.	0·93	inches.	6·97 inches.
,, Cardington, ,,	21	,, ,, ,,	1·66	,,	2·54	,,	0·88	,,	5·08 ,,
,, Nottingham, ,,	39	,, ,, ,,	1·84	,,	2·39	,,	0·99	,,	5·22 ,,
,, Holkham, ,,	4	,, ,, ,,	—	,,	2·46	,,	1·33	,,	— ,,

Fog prevailed on the 1st January at Lowestoft; on the 3rd at Totnes; on the 4th at Barnet, Cambridge, and Hull; on the 6th at Burslem, Royston, Cambridge, Rugby, Leicester, Bolton, Hull, and Stonyhurst; on the 7th at Totnes, Torquay, Marlborough, Oxford, Burslem, Cambridge, Rugby, Wolverhampton, and Hull; on the 10th at Marlborough, Whitchurch, and Wolverhampton; on the 11th at Ventnor, Osborne, Marlborough, and Wolverhampton; on the 12th at Marlborough, Rugby, Wolverhampton, and Hull; on the 13th at Marlborough; on the 14th at Totnes, Marlborough, Bolton, and Hull; on the 15th at Cambridge; on the 16th at Plymouth, Totnes, Barnet, Cambridge, Lowestoft, Hull, and Leeds; on the 17th at Plymouth and Marlborough; on the 18th at Guernsey, Totnes, Ventnor, and Bolton; on the 19th at Ventnor, Marlborough, Whitchurch, Barnet, Oxford, Burslem, Royston, Bedford, Cambridge, Rugby, Lowestoft, Wolverhampton, and Hull; on the 20th at Leicester; on the 21st at Barnet, Burslem, Cardington, Cambridge, Rugby, Lowestoft, and Hull; on the 22nd at Royston, Cardington, Cambridge, and Hull; on the 31st at Rugby, Bolton, and Hull.

In February, on the 1st at Totnes, Blackheath, Barnet, Royston, Cardington, Rugby, Leicester, and Hull; on the 2nd at Hull; on the 5th at Barnet, Cambridge, and Bolton; on the 6th at Salisbury; on the 7th at Royston; on the 8th at Torquay; on the 18th at Blackheath and Hull; on the 19th at Blackheath; on the 22nd at Guernsey; on the 23rd at Blackheath and Bolton; on the 24th at Totnes and Torquay; on the 25th at Torquay, Blackheath, and Bolton; on the 26th at Blackheath, Barnet, Oxford, Cardington, Cambridge, Rugby, Wolverhampton, and Leicester; on the 27th at Totnes and Torquay; on the 28th at Guernsey, Blackheath, Royston, and Cambridge.

In March, on the 1st and 2nd at Llandudno; on the 4th at Cambridge and Bolton; on the 5th at Guernsey, Blackheath, Royston, Bedford, Cambridge, and Rugby; on the 13th at Blackheath; on the 14th at Royston, Cambridge, Rugby, and Llandudno; on the 19th at Royston, Rugby, and Llandudno; on the 20th at Torquay and Llandudno; on the 21st at Ventnor; on 28th and 31st at Blackheath.

NAMES OF STATIONS.	Mean Pressure of dry Air reduced to the level of the Sea.	Highest Reading of the Thermometer.	Lowest Reading of the Thermometer.	Range of Temperature in the Quarter.	Mean of all Highest.	Mean of all Lowest.	Mean Monthly Range of Temperature.	Mean Daily Range of Temperature.	Mean Temperature of the Air.	Mean Temperature of the Dew Point.	Mean Elastic Force of Vapour.	Mean Weight of Vapour in a cubic foot of Air.	Mean additional Weight required for saturation.	Mean degree of Humidity.	Mean Weight of a cubic foot of Air.	Mean Reading of Maximum in Rays of Sun.	Mean Reading of Minimum on Grass.	Wind. Mean Estimated Strength.	Wind. Relative Proportion of N.	Wind. Relative Proportion of E.	Wind. Relative Proportion of S.	Wind. Relative Proportion of W.	Mean Amount of Ozone.	Rain. Mean Amount of Cloud.	Rain. Mean Number of Days on which it fell.	Rain. Mean Amount collected.
	in.	°	°	°	°	°	°	°	°	°	in.	grs.	gr.		grs.	°	°									in
Guernsey	29·744	55·0	27·9	27·1	47·0	38·8	21·5	8·7	42·4	38·7	·239	2·8	0·4	87	548	82·7	34·7	1·2	6	6	8	9	8·9	6·5	58	9·71
Truro	29·710	57·0	21·0	36·0	50·2	37·0	13·2	13·2	42·2	39·3	·243	2·8	0·4	88	551	—	—	2·6	5	7	7	11	—	6·1	50	13·21
Plymouth	29·742	57·6	24·5	33·1	48·8	36·8	12·0	12·0	42·6	39·7	·245	2·8	0·3	89	559	—	—	1·5	6	8	7	8	—	6·5	54	8·85
Totnes	29·795	57·5	18·2	39·3	49·4	35·1	13·1	14·3	42·6	37·6	·225	2·4	0·4	81	552	—	—	3·0	8	6	7	9	—	6·0	56	14·95
Torquay	29·742	57·6	23·3	34·3	48·5	36·3	12·2	12·2	42·5	37·4	·227	2·6	0·5	83	549	88·1	28·2	1·8	5	6	8	11	4·9	6·1	50	10·91
Ventnor	29·742	55·3	24·9	30·4	48·3	38·6	22·7	9·7	42·7	38·2	·236	2·6	0·5	82	551	—	—	1·5	6	7	7	9	5·4	6·0	50	6·55
Osborne	29·748	58·0	22·2	35·8	47·6	35·1	27·0	12·5	40·8	36·9	·228	2·6	0·4	86	552	83·7	33·1	0·3	6	6	10	8	—	6·0	47	7·40
Southbourne	29·752	56·2	23·1	33·1	47·2	36·2	26·7	11·0	41·8	37·2	·225	2·6	0·3	85	553	—	—	1·4	9	5	7	9	5·3	5·8	47	6·75
Salisbury	29·738	58·0	18·0	40·0	48·0	31·0	32·8	17·0	39·7	36·9	·221	2·5	0·3	90	552	78·3	18·8	1·1	7	6	9	7	—	6·5	59	10·14
Barnstaple	29·716	59·0	23·0	36·0	49·4	37·9	28·7	11·5	43·3	37·8	·229	2·6	0·6	80	549	—	—	1·2	6	7	9	8	—	4·0	51	9·38
Bath	29·742	53·4	18·1	35·3	44·1	33·7	28·1	10·5	39·1	35·9	·218	2·5	0·4	89	544	82·6	29·3	1·6	6	6	8	10	—	6·4	57	11·58
Strathfield Turgiss	29·766	56·1	13·8	42·3	47·1	33·1	32·6	14·0	40·2	36·5	·217	2·5	0·3	87	552	78·9	27·6	1·1	5	7	7	11	1·5	6·0	45	7·17
Marlborough	29·735	55·2	18·5	36·7	45·3	33·4	27·8	11·9	39·0	35·4	·207	2·4	0·4	86	548	79·2	30·2	1·4	6	8	8	7	—	6·4	53	10·35
Whitchurch	29·757	57·2	20·0	37·2	45·9	33·2	29·3	12·7	39·7	38·3	·234	2·8	0·3	95	553	—	—	—	6	7	8	8	—	6·2	53	7·12
Blackheath	29·768	54·3	24·0	30·3	45·7	35·1	25·6	10·7	39·9	35·5	·210	2·4	0·5	85	553	77·5	29·8	1·2	5	9	8	8	—	6·2	47	5·13
Royal Observatory	29·770	56·7	20·6	36·1	46·0	34·3	28·9	11·7	40·0	35·9	·207	2·4	0·5	83	555	74·8	29·4	—	-	-	-	-	5·6	6·5	48	5·30
Camden Square	29·762	57·3	22·4	34·9	46·7	34·6	29·7	12·1	40·5	36·2	·209	2·5	0·5	85	553	68·3	31·4	—	-	-	-	-	—	6·5	46	6·30
Barnet	29·782	55·5	17·7	37·8	46·2	32·2	28·4	14·0	39·0	35·7	·211	2·5	0·4	89	553	78·2	26·7	1·1	6	8	5	11	—	6·5	44	6·10
Oxford	29·747	56·2	20·5	35·7	47·1	35·5	28·6	11·6	40·8	36·4	·218	2·5	0·5	85	551	82·6	30·4	3·1	5	7	9	9	1·2	6·2	50	7·24
Burslem	29·724	54·7	19·6	35·1	43·5	33·1	27·2	10·4	37·8	35·0	·205	2·4	0·3	90	546	—	—	0·8	5	6	11	8	—	7·4	61	7·00
Royston	29·768	54·4	16·8	37·6	45·1	33·3	29·1	11·8	38·8	34·6	·201	2·4	0·3	84	552	—	—	—	6	7	8	9	—	6·1	48	5·30
Cardington	—	57·6	17·2	40·4	46·4	33·0	32·3	13·4	39·4	36·5	·218	2·4	0·3	90	—	80·7	29·8	1·4	6	6	7	11	—	6·7	46	5·10
Cambridge	29·723	57·9	15·0	42·9	46·5	33·5	34·3	13·0	39·6	36·4	·217	2·5	0·3	88	555	82·6	27·3	1·3	4	6	9	11	—	6·6	47	4·15
Rugby	29·631	56·0	10·0	46·0	45·4	31·2	33·9	14·2	38·0	34·3	·202	2·3	0·4	85	549	—	—	0·6	5	7	10	8	4·7	6·5	46	6·04
Lowestoft	29·737	55·4	22·6	31·8	44·3	34·6	26·1	9·7	39·4	35·5	·206	2·4	0·5	86	554	79·6	30·9	0·7	4	7	7	12	—	6·4	50	5·11
Somerleyton	29·743	55·2	21·5	33·7	44·8	33·1	29·5	11·7	38·4	35·8	·212	2·4	0·3	90	556	—	—	1·1	4	8	8	10	5·9	6·8	53	3·50
Wolverhampton	29·785	54·7	17·0	37·7	43·9	31·4	29·6	12·8	37·8	33·5	·194	2·3	0·6	85	547	—	—	—	4	8	10	8	—	7·2	42	2·70
Leicester	29·723	57·0	16·0	41·0	45·3	33·8	30·2	11·5	39·2	35·5	·209	2·4	0·4	86	552	73·3	29·2	0·8	4	5	10	10	—	6·8	56	6·12
Nottingham	29·724	58·0	15·0	43·0	45·2	32·9	32·3	12·3	38·9	35·4	·209	2·5	0·3	87	552	66·9	32·6	0·4	4	8	10	9	1·7	7·3	54	5·14
Holkham	29·729	54·6	16·4	38·2	44·1	30·9	31·7	13·2	38·9	35·8	·206	2·5	0·2	90	557	78·2	26·7	1·7	5	6	14	5	—	6·5	37	6·77
Llandudno	29·787	54·8	26·0	28·8	45·9	36·4	24·4	9·5	41·4	36·7	·219	2·5	0·5	82	551	—	—	1·2	2	5	9	14	—	6·6	49	7·00
Liverpool	29·698	56·0	26·4	29·6	44·8	36·0	25·4	8·8	39·9	35·1	·206	2·4	0·5	86	551	—	—	—	4	10	6	10	—	6·3	53	5·04
Bolton	29·714	55·4	19·0	36·4	43·5	32·8	29·9	11·2	38·0	34·6	·201	2·4	0·3	87	547	50·8	23·0	2·0	4	7	10	9	2·9	7·0	59	11·64
Hull	29·724	56·0	10·0	46·0	45·2	32·0	34·7	13·2	39·8	35·1	·207	2·4	0·5	85	556	59·3	30·7	1·8	4	6	14	6	—	5·2	53	6·07
Stonyhurst	29·720	55·9	17·8	37·4	44·8	32·0	31·0	12·8	38·1	34·0	·198	2·3	0·5	84	550	79·5	30·7	—	5	8	7	11	—	7·7	54	9·35
Bradford	29·699	54·4	19·8	34·6	43·8	34·5	29·4	9·3	38·9	34·1	·204	2·4	0·4	86	548	56·0	—	1·0	5	5	8	11	—	6·9	51	7·34
Leeds	29·649	58·0	20·0	38·0	45·5	35·1	31·0	10·4	40·2	36·0	·215	2·4	0·4	85	552	—	—	1·2	5	6	7	12	—	7·4	44	6·25
Lancaster	29·675	56·0	20·0	36·0	45·0	33·5	30·0	11·5	39·2	35·1	·206	2·4	0·4	85	553	—	—	—	-	-	-	-	—	—	47	10·57
Silloth	29·654	56·0	21·3	32·7	44·5	34·5	26·6	10·0	39·2	35·1	·207	2·3	0·5	83	554	81·0	31·1	1·8	5	8	7	10	7·3	8·7	46	6·72
Carlisle	29·651	59·3	18·7	45·6	45·5	32·2	36·8	13·3	38·7	34·9	·205	2·4	0·3	86	553	65·6	24·8	1·1	3	9	7	11	3·8	7·4	35	6·55

The highest temperatures of the air were at Carlisle, 59°·3; at Barnstaple, 59°; and at Osborne, Salisbury, Nottingham, and Leeds, 58°.
The lowest temperatures of the air were at Rugby and Hull, 10°; at Carlisle, 18°·7; and at Strathfield Turgiss, 13°·8.
The greatest ranges of temperature were at Salisbury, 17°; at Rugby, 14°·2; and at Strathfield Turgiss and Barnet, 14°.
The least daily ranges of temperature were at Guernsey, 8°·7; at Liverpool, 8°·8; and at Bradford, 9°·3.
The greatest number of days of rain were at Burslem, 61; at Salisbury and Bolton, 59; and at Guernsey, 58.
The least number of days of rain were at Carlisle, 35; at Holkham, 37; and at Wolverhampton, 42.
The greatest falls of rain were at Totnes, 14·95 inches; at Truro, 13·21 inches; and at Bolton, 11·64 inches.
The least falls of rain were at Cambridge, 4·68 inches; at Blackheath, 5·12 inches; and at Greenwich, 5·36 inches.

Quarterly Meteorological Table for different Parallels of Latitude.

PARALLELS OF LATITUDE, &c.	Mean Pressure of dry Air reduced to the level of the Sea.	Mean of all Highest Readings of the Thermometer.	Mean of all Lowest Readings of the Thermometer.	Mean Range of Temperature in the Quarter.	Mean of all Highest.	Mean of all Lowest.	Mean Monthly Range of Temperature.	Mean Daily Range of Temperature.	Mean Temperature of the Air.	Mean Temperature of the Dew Point.	Mean Elastic Force of Vapour.	Mean Weight of Vapour in a cubic foot of Air.	Mean additional Weight required for saturation.	Mean degree of Humidity.	Mean Weight of a cubic foot of Air.	Mean Reading of Maximum in Rays of Sun.	Mean Reading of Minimum on Grass.	Wind. Mean Estimated Strength.	Wind. Relative Proportion of N.	Wind. Relative Proportion of E.	Wind. Relative Proportion of S.	Wind. Relative Proportion of W.	Mean Amount of Ozone.	Rain. Mean Amount of Cloud.	Rain. Mean Number of Days it fell.	Rain. Mean Amount collected.
	in.	°	°	°	°	°	°	°	°	°	in.	grs.	gr.		grs.	°	°									in
Guernsey	29·744	55·0	27·9	27·1	47·0	38·8	21·5	8·7	42·4	38·7	·239	2·8	0·4	87	548	82·7	34·7	1·2	6	6	8	9	8·9	6·5	58	9·71
Between the latitudes 49° and 51°	29·739	57·0	21·2	28·8	48·4	34·7	27·1	11·7	42·0	38·1	·233	2·7	0·4	85	551	85·9	30·7	1·5	6	7	8	9	5·2	6·0	50	8·87
Between the latitudes 51° and 52°	29·752	56·4	19·8	36·6	46·4	31·9	27·7	12·5	38·0	35·2	·215	2·5	0·4	86	551	76·6	29·8	1·4	6	7	8	9	2·1	6·2	51	7·31
Between the latitudes 52° and 53°	29·730	57·0	16·8	40·2	45·1	32·8	30·9	12·3	38·8	35·3	·207	2·4	0·4	87	553	72·7	29·4	0·8	5	7	9	9	4·1	6·5	48	6·53
Between the latitudes 53° and 54°	29·623	55·7	19·9	35·8	44·8	34·0	29·5	10·8	39·4	35·2	·207	2·4	0·4	85	551	61·3	29·1	1·2	4	7	9	10	—	6·7	51	5·30
Between the latitudes 54° and 55°	29·653	57·7	18·5	39·2	45·0	33·8	31·7	11·7	39·0	35·0	·206	2·4	0·4	84	554	73·3	28·0	1·5	4	9	7	11	5·6	6·6	40	4·74
Mean for the Quarter, 50° to 55° Year 1880	29·837	60·6	17·6	43·0	46·6	34·6	31·7	12·0	40·4	36·4	·218	2·5	0·4	86	553	70·9	29·8	1·2	4	10	8	8	4·1	6·4	53	5·31
" 1881	29·677	58·2	6·8	51·4	42·4	30·8	35·0	11·6	36·1	32·7	·190	2·2	0·3	87	554	66·8	26·6	1·2	7	9	5	9	—	6·9	40	7·29
" 1882	29·907	60·6	25·6	35·0	48·9	37·6	29·7	11·3	45·1	39·4	·243	2·8	0·4	87	554	71·9	32·7	1·2	3	4	10	14	3·6	7·1	41	6·11
" 1883	29·699	56·5	19·6	36·9	45·9	34·1	29·4	11·8	39·4	34·0	·214	2·5	0·4	85	552	74·0	29·8	1·3	5	7	8	10	4·2	6·4	48	6·55

METEOROLOGY OF ENGLAND,

DURING THE QUARTER ENDING JUNE 30, 1883.

REMARKS ON THE WEATHER DURING THE QUARTER ENDING JUNE 30TH, 1883.

By JAMES GLAISHER, Esq., F.R.S., *&c.*

The weather in April:—At the beginning of the month there were a few fine warm days, but from the 9th to the 25th the weather was cold and ungenial, snow fell generally on several days. The days were frequently bright, and the nights cold; but on the whole the month was dry, no rain falling at the beginning of the month and but little afterwards, being favourable for farming operations. The month was free from thunderstorms.

The weather in May:—The first twelve days were cold and rain or snow fell on several days at stations north of 51°. From the 12th the weather was warm and pleasant and at times hot; this fine weather continued to the end of the month. The fall of rain was generally below the average. Thunderstorms occurred on six days.

The weather in June was variable; at the beginning of the month it was warm and fine, then for a few days it was cold and warm alternately, it was very cold from the 15th to the 22nd, and unsettled afterwards to the end of the month. The fall of rain was generally below its average, on the whole the month was favourable for vegetation and farming work. Thunderstorms occurred on ten days.

About London the mean daily temperature of the air was above its average till the 8th day, and the mean daily excess of these 8 days was 3°·8; it was generally below its average from the 9th to the 26th, the average daily deficiency of these 18 days being 1°·7; from April 27th to May 1st it was slightly warmer, the mean daily excess being 1°·6; the first 11 days in May were cold, and the average daily deficiency of mean temperature was 6°·1; a warmer period set in on the 13th of May and continued with few exceptions to June 14th, the mean daily excess of these 33 days was 2°·4; from the 15th of June till the 22nd the weather was very cold, the average daily deficiency of mean temperature being 5°·2; from the 23rd to the 25th it was warmer, being 1°·9 above the average; from June 26th to the 28th it was 4°·0 below the average; and the three days at the end of the quarter were warm, being 6°·4 above the average.

The mean temperature of the air for April was 46°·8 being 0°·7 above the averages of 112 years, and 0°·3 below the average of 42 years, it was 1°·1 lower than in 1882, 0°·9 higher than in 1881, and 0°·3 lower than in 1880.

The mean temperature for May was 53°·1, being 0°·6 and 0°·4 above the averages of 112 years and 42 years; it was 1°·4 and 1°·0 lower than in 1882 and 1881 respectively, and 0°·5 higher than in 1880.

The mean temperature for June was 59°·0 being 0°·8 and 0°·1 above the averages of 112 years and 42 years respectively; it was 2°·5, 0°·3 and 1°·5 higher than in 1882, 1881, and 1880 respectively.

The mean temperature for the quarter was 53°·0, being 0°·7 and 0°·1 above the averages of 112 years and 42 years respectively.

The mean high day temperature of the air in April was 57°·6, being the same as the average of 42 years; in May it was 63°·7, being 0°·5 lower than the average, and in June was 70°·8, being 0°·1 below the average.

The mean low night temperature of the air in April was 37°·4, being 1°·8 below the average of 42 years; in May it was 43°·5, being 0°·2 below the average; and in June it was 48°·9, being 1°·0 below the average.

The mean daily range of temperature in April was 1°·8 higher than the average, in May it was 0°·3 lower than the average, and in June it was 1°·0 higher than the average.

The mean temperature of the air in April was 10°·7 higher than in March; in May it was 6°·3 higher than April, and in June it was 5°·9 higher than in May.

(From the preceding 42 years' observations the increase of temperature from March to April is 5°·3; the increase of temperature from April to May is 5°·6, and the increase from May to June is 6°·2.)

From March to April there was an increase of temperature at stations south of 51° of 7°·8, between 51° and 52° of 10°·3, between 52° and 53° of 10°·5, between 53° and 54° of 9°·8, and between 54° and 55° of 9°·8.

From April to May there was an increase of temperature at stations south of 51° of 4°·1, between 51° and 52° of 5°·1, between 52° and 53° of 5°·3, between 53° and 54° of 3°·5, and between 54° and 55° of 3°·4.

From May to June there was a increase of temperature at stations south of 51° of 5°·2, between 51° and 52° of 5°·9, between 52° and 53° of 5°·6, between 53° and 54° of 5°·5, and between 54° and 55° of 5°·6.

About London the mean daily pressure of the atmosphere was above the average till the 12th day, and the mean daily excess of these 12 days was 0·42 in. On April 13th the reading passed below the average, and continued so with but few exceptions to May 12th, the average daily deficiency of pressure for these 30 days was 0·15 in. From May 13th till the 24th the pressure was above the average daily by 0·21 in.; then for two days it was below, and from May 27th to June 3rd there was an excess of 0·13 in. daily, then for six days there was a deficiency averaging 0·12 in. daily. From June 10th to the 14th there was an excess of 0·24 in. daily; on the 15th

the reading was below, and continued so till the 21st, the average deficiency was 0·07 in., the 22nd and 23rd were above by 0·04 in., and from the 24th to the 28th there was a mean deficiency of 0·10 in., and the last two days of the quarter, there was an excess of 0·02 in.

1883. Months.	Temperature of Air. Mean.	Air. Diff. from average of 112 years.	Air. Diff. from average of 42 years.	Evaporation. Mean.	Evaporation. Diff. from average of 42 years.	Dew Point. Mean.	Dew Point. Diff. from average of 42 years.	Air—Daily Range. Mean.	Air—Daily Range. Diff. from average of 42 years.	Elastic Force of Vapour. Mean.	Elastic Force of Vapour. Diff. from average of 42 years.	Weight of Vapour in a Cubic Foot of Air. Mean.	Weight of Vapour in a Cubic Foot of Air. Diff. from average of 42 years.
	°	°	°	°	°	°	°	°	°	in.	in.	grs.	gr.
April -	46·8	+0·7	−0·3	43·8	−0·7	39·4	−1·1	20·2	+1·8	·249	−0·004	2·8	−0·1
May -	53·1	+0·6	+0·4	49·2	+0·4	45·3	+0·3	20·2	−0·3	·303	+0·005	3·4	−0·1
June -	59·0	+0·8	+0·1	54·9	+0·4	51·3	+0·7	21·9	+1·0	·378	+0·008	4·3	+0·2
Means -	53·0	+0·7	+0·1	49·1	0·0	45·3	0·0	20·8	+0·8	·310	+0·003	3·5	0·0

1883. Months.	Degree of Humidity. Mean.	Degree of Humidity. Diff. from average of 42 years.	Reading of Barometer. Mean.	Reading of Barometer. Diff. from average of 42 years.	Weight of a Cubic Foot of Air. Mean.	Weight of a Cubic Foot of Air. Diff. from average of 42 years.	Rain. Amount.	Rain. Diff. from average of 67 years.	Daily Horizontal movement of the Air.	Reading of Thermometer on Grass. Number of Nights it was At or below 30°.	Between 30° and 40°.	Above 40°.	Lowest Reading at Night.	Highest Reading at Night.
			in.	in.	grs.	grs.	in.	in.	Miles.				°	°
April -	79	− 1	29·826	+0·076	545	+ 2	1·70	−0·06	227	13	13	4	18·6	48·1
May -	76	− 1	29·784	−0·007	538	− 3	1·71	−0·36	246	5	17	9	23·9	49·6
June -	76	+ 1	29·793	−0·012	531	− 1	1·34	−0·66	255	0	9	21	31·0	56·3
Means -	77	0	29·801	+0·019	538	− 1	Sum 4·75	Sum −1·08	Mean 243	Sum 18	Sum 39	Sum 34	Lowest 18·6	Highest 56·8

NOTE.—In reading this table it will be borne in mind that the plus sign (+) signifies *above* the average, and that the minus sign (−) signifies *below* the average.

The average duration of the different directions of the wind referred to eight points of the compass, and the duration of each direction in each month in the quarter, were as follows:—

Direction of Wind.	April. 1883.	April. Average.	April. Departure from Average.	May. 1883.	May. Average.	May. Departure from Average.	June. 1883.	June. Average.	June. Departure from Average.
	d.	d.	d.	d.	d.	d.	d.	d.	d.
N.W.	2¼	2¼	0	4¼	1½	+2¾	2	2½	− ½
N.	1	4¼	− 3¼	4¼	4¾	− ½	1¼	3¼	−1¾
N.E.	3¼	6½	− 2¾	5¼	7¼	−2¼	5¼	3¾	+1¾
E.	5	3¼	+ 1¾	2	2¼	− ¼	1¾	2¼	− ½
S.E.	4	2½	+ 1½	1¾	1¾	0	1	1¾	− ¾
S.	¾	2½	− 1¾	2	2¾	− ¾	6	2¼	+3¾
S.W.	4¼	6¼	− 1¾	7¼	8	− ¾	7½	10	−2½
W.	8¼	2¼	+ 5¾	3¼	2¼	+1¼	4¼	4	+ ¼

The plus sign (+) denotes excesses over averages; the largest numbers affected with this sign in the month of April are opposite to W. and S.E.; in May to N.W. and W.; and in June to S. and N.E.

The minus sign (−) denotes deficiencies below averages. In April the largest numbers are opposite to N. and N.E.; in May to N.E. and S.; and in June to S.W. and N.

The mean reading of the barometer for the month of April at the height of 160 feet above the level of the sea was 29·826 ins., being 0·076 in. above the average of 42 years; 0·224 in. above that of 1882; and 0·054 in. above that of 1881.

The mean reading of the barometer for the month of May was 29·784 ins., being 0·007 in. below the average of 42 years, 0·091 in. below that of 1882, and 0·145 in. below that of 1881.

The mean reading of the barometer for the month of June was 29·793 ins., being 0·012 in. lower than the average of 42 years, 0·058 in. above that of 1882, and 0·013 in. below that of 1881.

(From the 42 preceding years' observations the mean pressure of April is 0·001 in. higher than in March; that in May is 0·041 in. higher that in April, and that in June is 0·014 in. higher than in May.)

From March to April there was an increase of pressure at stations south of 51 of 0·060 in.; between 51° and 52° of 0·077 in.; between 52° and 53° of 0·076 in.; between 53° and 54° of 0·054 in. and north of 54° of 0·050 in.

From April to May there was a decrease of pressure at stations south of 51° of 0·027 in.; between 51° and 52° of 0·044 in., between 52° and 53° of 0·047 in. between 53° and 54° of 0·042 in. and north of 54° of 0·052 in.

From May to June there was a decrease at stations south of 50° of 0·003 in., and increase between 51° and 52° of 0·002 in., between 52° and 53° of 0·011 in., and a decrease between 53° and 54° of 0·001 in., and north of 54° of 0·012 in.

Thunderstorms occurred in May on the 6th at Truro, Plymouth, and Torquay; on the 15th at Lowestoft; on the 16th at Plymouth; on the 24th at Whitchurch; on the 25th a Torquay, Lowestoft, Somerleyton, Bolton, and Halifax; and on the 26th at Torquay.

In June, on the 1st at Halifax; on the 8th at Oxford, Wolverhampton, Leicester, Halifax, and Stonyhurst; on the 9th at Strathfield Turgiss, Whitchurch, Oxford, Bedford, and Leicester, on the 10th at Southbourne, Strathfield Turgiss, Oxford, Rugby, and Stonyhurst; on the 15th at Llandudno and Stonyhurst; on the 21st at Osborne and Oxford; on the 25th at Burslem, Royston, Bedford, Cambridge, Lowestoft, Leicester, Llandudno, Bolton, Halifax, Stonyhurst, and Bradford; on the 26th at Whitchurch, Blackheath, Barnet, Royston, Bedford, Cambridge, Rugby, Wolverhampton, Leicester, Bolton, and Bradford; on the 29th at Guernsey, Torquay, Ventnor, Southbourne, Whitchurch, Burslem, Wolverhampton, Leicester, Halifax, Stonyhurst, and Bradford; on the 30th at Blackheath, Barnet, Royston, Rugby, Halifax, and Bradford.

Thunder was heard but lightning was not seen in May, on the 1st at Torquay; on the 3rd at Wolverhampton; on the 6th at Plymouth; on the 11th at Blackheath and Barnet; on the 25th at Oxford, Royston, and Rugby; and on the 26th at Guernsey and Cockermouth.

In June on the 4th at Osborne; on the 5th at Totnes and Torquay; on the 6th at Osborne; on the 8th at Burslem, Liverpool, and Bolton; on the 9th at Ventnor, Burslem, Rugby, and Halifax; on the 10th at Osborne, Whitchurch, and Bedford; on the 13th at Oxford and Cambridge; on the 14th at Oxford; on the 15th at Halifax; on the 16th at Carlisle; on the 18th at Halifax; on the 21st at Blackheath, Barnet, Oxford, and Cambridge; on the 23rd at Carlisle and Silloth; on the 24th at Truro; on the 25th at Rugby; and on the 26th at Oxford and Cambridge; and on the 30th at Cambridge.

Lightning was seen but thunder was not heard in May, on the 5th at Plymouth; and on the 25th at Wolverhampton and Stonyhurst. In June, on the 3rd at Guernsey, Truro, and Torquay; on the 4th, 5th, and 9th at Torquay, on the 10th at Whitchurch, on the 13th at Royston and Cambridge; on the 14th at Lowestoft, on the 24th at Blackheath, on the 25th at Lowestoft and Carlisle; and on the 29th at Torquay, Osborne, Royston, and Cambridge.

Solar halos were seen in April, on the 1st at Torquay, Oxford, and Halifax; on the 4th at Oxford; on the 7th at Torquay, Strathfield Turgiss, and Oxford; on the 10th at Oxford; on the 13th at Hull; on the 14th at Halifax; on the 16th and 19th at Torquay and Oxford; on the 20th and 24th at Oxford; on the 26th at Torquay, Oxford, and Halifax; on the 27th at Halifax.

In May, on the 3rd at Torquay; on the 6th at Torquay and Oxford; on the 7th at Stonyhurst; on the 10th at Torquay and Oxford, on the 14th and 16th at Halifax, on the 17th and 18th at Torquay and Oxford; on the 22nd at Torquay, Halifax, and Stonyhurst; on the 25th at Halifax and Stonyhurst.

In June, on the 2nd at Stonyhurst; on the 5th at Torquay; on the 9th at Stonyhurst; on the 14th at Liverpool and Halifax; on the 16th at Halifax; on the 18th at Stonyhurst; on the 22nd, 25th, and 29th at Torquay.

Lunar halos were seen in April, on the 14th and 16th at Oxford and Halifax; on the 16th at Royston, Cambridge, Lowestoft, and Leicester; on the 17th at Bolton; and on the 18th at Torquay.

In May on the 13th at Ventnor, Marlborough, Oxford, and Leicester; on the 16th at Bolton; on the 17th at Oxford, Rugby, and Halifax; on the 18th at Oxford; and on the 22nd at Halifax.

Aurora borealis was seen in April, on the 2nd at Whitchurch; and on the 3rd at Stonyhurst.

In May on the 11th at Stonyhurst; and on the 26th at Whitchurch.

Snow fell in April, on the 22nd at Bedford and Hull; on the 23rd at Torquay, Ventnor, Osborne, Salisbury, Marlborough, Barnet, Oxford, Burslem, Royston, Cambridge, Rugby, Lowestoft, Somerleyton, Wolverhampton, Llandudno, Bolton, Halifax, and Hull; on the 24th at Torquay, Ventnor, Osborne, Bedford, and Stonyhurst; on the 27th at Whitchurch.

In May, on the 2nd, 3rd, and 4th at Halifax; on the 4th at Rugby, Wolverhampton, and Llandudno; on the 5th at Rugby; on the 8th at Halifax; on the 10th at Salisbury, Marlborough, and Whitchurch; on the 11th at Burslem and Halifax; and on the 12th at Halifax.

Hail fell in April, on the 20th at Truro and Salisbury; on the 22nd at Oxford, Bedford, and Hull; on the 23rd at Torquay, Salisbury, Marlborough, Barnet, Oxford, Royston, Bedford, Cambridge, Rugby, and Hull; on the 24th at Barnet, Oxford, Royston, and Bedford; and on the 25th at Torquay.

In May, on the 3rd at Torquay, Burslem, Royston, and Lowestoft; on the 4th at Oxford, Royston, Rugby, and Wolverhampton; on the 6th at Torquay; on the 9th at Torquay; on the 10th at Oxford, Lowestoft, and Bolton; and on the 11th at Torquay, Marlborough, Barnet, Oxford, Burslem, Rugby, Wolverhampton, Bolton, Halifax, and Stonyhurst.

In June, on the 9th at Leicester; on the 16th at Torquay; on the 25th at Royston and Cambridge; on the 26th at Royston, Bedford, and Wolverhampton; and on the 29th at Whitchurch and Leicester.

MONTHLY METEOROLOGICAL TABLE FOR THE QUARTER ENDING JUNE 30TH, 1883.

The Observations have been reduced to Mean values by Glaisher's Barometrical and Diurnal Range Tables, and the Hygrometrical results have been deduced from the sixth edition of his Hygrometrical Tables.

Names of Stations and Observers.	Height of Station above Sea Level.	Year 1883.	Pressure of Atmosphere in Month.		Temperature of Air in Month.						Mean Temperature.		Vapour.			Mean Degree of Humidity. Sat°. = 100.	Mean Weight of a cubic foot of Air.	Mean Reading of Thermometer.		Wind.					Mean Amount of Ozone.	Mean Amount of Cloud.	Rain.	
								Mean						In a cubic foot of Air.						Estimated Strength.	Relative Proportion of						Number of Days it fell.	Amount collected.
		Months.	Mean.	Range.	Highest.	Lowest.	Range.	Of all Highest.	Of all Lowest	Daily Range.	Air.	Dew Point.	Elastic Force.	Mean.	Short of Saturation.			Maximum in Rays of Sun.	Minimum on Grass.		N.	E.	S.	W.				
	feet.		in.	in.	°	°	°	°	°	°	°	°	in.	grs.	gr.		grs.	°	°								
GUERNSEY, Adolphus Collenette, Esq., F.M.S.	270	April	29·704	1·316	63·2	32·8	30·4	52·9	41·6	11·3	46·4	41·7	·264	3·1	0·5	85	544	103·8	34·8	0·7	12	6	6	6	4·0	5·6	10	1·25
		May	29·689	0·879	69·2	38·8	30·4	57·6	45·0	12·6	50·3	45·6	·306	3·5	0·7	84	539	109·2	39·9	0·7	15	6	6	6	1·5	5·3	15	2·73
		June	29·695	0·860	72·2	41·0	31·2	62·7	51·7	11·0	55·7	52·6	·401	4·5	0·5	89	533	113·3	48·8	0·8	9	3	8	10	2·7	5·6	15	2·58
TRURO (Cornwall), C. Barham, Esq., M.D., F.M.S.	45	April	29·930	1·486	65·0	28·0	37·0	56·5	37·3	19·2	45·0	38·9	·243	2·8	0·6	81	549	—	—	2·4	5	10	7	8	—	6·6	12	1·66
		May	29·899	0·866	78·0	28·0	50·0	60·7	43·0	17·7	49·7	43·1	·279	3·2	0·8	79	544	—	—	2·3	7	5	8	11	—	6·4	12	1·86
		June	29·876	0·734	75·0	41·0	34·0	66·5	49·5	17·6	54·6	51·3	·378	4·3	0·5	87	537	—	—	2·4	5	6	8	11	—	6·9	16	2·82
PLYMOUTH (Devon), J. Merrifield, Esq., LL.D., F.R.A.S., F.M.S.	69	April	29·930	1·438	60·0	34·5	25·5	55·4	42·3	13·1	47·6	42·1	·288	3·1	0·7	82	546	—	—	1·4	8	15	8	4	—	5·4	8	0·75
		May	29·904	0·876	74·0	35·0	37·0	59·5	45·9	13·6	51·8	46·0	·311	3·5	0·7	80	541	—	—	1·3	7	10	7	7	—	6·9	12	2·62
		June	29·884	0·792	74·5	42·0	32·5	64·6	51·9	12·7	56·6	51·8	·385	4·3	0·8	84	535	—	—	1·3	5	6	11	8	—	6·9	18	3·07
TOTNES (Devon), T. H. Edmonds, Esq.	107	April	29·926	1·412	62·0	27·6	34·4	46·3	36·5	10·8	46·0	39·2	·240	2·8	0·8	78	548	—	—	1·7	6	9	8	7	—	5·1	11	1·15
		May	29·894	0·815	72·7	28·0	44·7	60·9	41·0	14·9	50·8	44·3	·202	3·3	0·9	79	542	—	—	1·8	10	5	9	7	—	6·0	18	3·12
		June	29·884	0·685	74·7	36·8	27·9	66·3	47·8	18·5	55·9	49·1	·388	3·3	1·0	81	536	—	—	1·6	8	9	8	5	—	6·9	19	3·80
TORQUAY, Babbacombe (Devon), Edwin E. Glyde, Esq., F.M.S.	305	April	29·669	1·372	58·7	33·1	25·6	53·0	39·6	14·3	45·9	39·5	·244	2·8	0·8	79	544	110·2	30·5	1·2	7	10	6	7	5·1	7·5	11	0·83
		May	29·630	0·882	72·8	31·6	38·2	58·4	44·0	14·4	50·2	43·6	·284	3·3	0·8	79	538	117·6	35·2	1·2	10	7	6	8	5·3	6·4	13	2·30
		June	29·650	0·638	74·8	41·0	31·8	63·3	49·5	13·8	55·1	48·8	·347	3·9	1·0	79	533	118·3	42·8	1·6	8	8	5	9	5·1	6·8	18	3·17
VENTNOR, (Isle of Wight) (Royal National Hospital for Consumption), Hartley Sagar, Esq.	80	April	29·909	1·232	60·9	32·3	28·6	54·5	41·3	13·2	46·4	40·9	·257	3·0	0·7	83	548	—	—	1·6	8	10	6	6	6·6	5·1	7	1·66
		May	29·879	0·952	70·2	33·5	36·7	59·3	45·8	13·5	50·8	45·9	·310	3·5	0·7	84	542	—	—	1·1	12	6	5	8	6·2	6·2	11	2·61
		June	29·872	0·622	73·5	44·9	28·6	65·9	51·8	14·1	56·6	52·8	·400	4·5	0·6	87	535	—	—	1·1	6	7	6	11	5·8	6·9	18	1·37
EASTBOURNE, (Sussex), Miss W. L. Hall.	12	Jan.	29·885	1·370	54·9	29·9	25·0	46·7	39·3	7·4	43·0	38·8	·236	2·7	0·5	85	551	62·5	27·0	2·5	3	8	9	11	—	—	19	2·28
		Feb.	30·014	1·641	54·6	30·2	24·4	48·6	40·2	8·4	43·6	41·0	·257	2·9	0·2	89	553	77·7	36·1	0·3	6	1	10	11	—	—	19	3·50
		Mar.	29·843	1·448	52·8	22·1	30·7	44·0	31·9	12·1	37·1	32·1	·181	2·1	0·5	82	557	94·3	28·5	0·3	14	8	8	6	—	—	10	1·04
		April	29·945	1·196	65·4	30·6	34·8	56·6	38·7	17·9	46·1	39·5	·243	2·8	0·8	78	549	106·1	32·3	0·2	7	10	8	5	—	—	5	1·70
		May	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
		June	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
OSBORNE (Isle of Wight), J. R. Mann, Esq.	172	April	29·827	1·246	67·2	30·5	36·7	58·1	37·8	20·3	46·2	41·4	·262	3·1	0·6	84	546	112·3	35·6	0·1	6	8	10	6	—	4·3	6	0·92
		May	29·785	0·890	74·4	31·9	42·5	63·1	45·6	19·5	51·7	47·1	·325	3·8	0·9	85	539	118·5	41·3	0·1	11	5	8	7	—	4·8	11	2·44
		June	29·791	0·864	79·3	40·2	39·1	70·2	49·8	20·4	57·8	54·0	·418	4·6	0·7	87	532	128·3	46·5	0·1	4	5	11	10	—	5·3	13	1·61
SOUTHBOURNE, (near) Bournemouth (Hants), T. A. Compton, Esq., M.D., B.A., F.M.S.	95	April	29·895	1·296	61·3	30·2	31·1	53·7	38·4	15·3	45·4	38·5	·234	2·7	0·8	77	548	—	—	1·9	10	8	8	4	—	5·0	7	0·61
		May	29·841	0·896	73·4	30·9	42·5	58·2	43·7	14·5	50·2	43·6	·244	3·3	0·8	79	542	—	—	1·7	14	5	8	4	—	5·3	14	2·20
		June	29·830	0·656	76·1	39·3	36·8	64·2	49·5	14·7	56·0	49·2	·352	3·9	1·0	78	535	—	—	1·1	7	5	10	8	—	4·5	11	2·12
BRIGHTON, F. E. Sawyer, Esq., F.M.S.	206	Jan.	29·719	1·390	52·0	29·6	22·4	45·8	37·9	7·9	42·0	38·4	·233	2·7	0·4	82	549	—	33·1	0·9	7	10	4	10	—	7·6	20	2·26
		Feb.	29·854	1·498	54·0	32·4	21·6	47·4	38·4	9·0	42·3	37·4	·224	2·6	0·5	84	551	—	33·1	1·0	5	2	10	11	—	8·0	19	3·34
		Mar.	29·696	1·470	51·0	23·0	28·0	43·1	31·0	12·1	37·4	30·0	·167	1·9	0·7	75	534	—	29·8	1·6	13	10	8	5	—	4·6	11	1·06
		April	29·744	1·202	64·0	31·0	33·0	54·5	39·5	15·0	46·0	38·8	·221	2·6	0·9	75	545	96·7	34·5	1·2	7	8	8	7	—	6·2	6	1·34
		May	29·743	0·981	72·7	34·0	38·7	61·0	44·8	16·2	51·8	44·8	·197	3·4	1·0	77	539	103·6	40·5	0·9	9	7	6	9	—	5·6	13	2·09
		June	29·748	0·619	79·0	42·6	36·4	69·2	50·6	18·6	58·5	50·5	·368	4·1	1·4	75	531	113·9	44·5	1·0	5	6	10	9	—	6·2	18	0·67

Names of Stations and Observers.	Height of Station above Sea Level.	Year 1883.	Pressure of Atmosphere in Month.		Temperature of Air in Month.						Mean Temperature.		Vapour.			Mean Degree of Humidity. Sat^{n}. = 100.	Mean Weight of a cubic foot of Air.	Mean Reading of Thermometer.		Wind.					Mean Amount of Ozone.	Mean Amount of Cloud.	Rain.	
								Mean						In a Cubic foot of Air.						Relative Proportion of							
		Months.	Mean.	Range.	Highest.	Lowest.	Range.	Of all Highest.	Of all Lowest.	Daily Range.	Air.	Dew Point.	Elastic Force.	Mean.	Short of Saturation.			Maximum in Rays of Sun.	Minimum on Grass.	Estimated Strength.	N.	E.	S.	W.			Number of Days it fell.	Amount collected.
	feet.		in.	in.	°	°	°	°	°	°	°	°	in.	grs.	gr.		grs.	°	°								in.
SALISBURY (Wilton House), Wilts, Thomas Challis, Esq.	186	April	29·792	1·294	67·0	24·5	42·5	59·9	33·9	26·0	46·0	39·6	·244	2·8	0·8	79	546	112·1	30·3	1·1	7	9	9	5	—	6·1	10	1·22
		May	29·762	0·906	78·0	27·0	51·0	65·4	39·7	25·7	51·7	46·7	·320	3·6	0·9	85	539	114·0	38·4	1·1	8	9	7	6	—	6·6	16	1·92
		June	29·771	0·654	84·0	36·0	48·0	71·2	45·8	25·4	57·1	50·5	·360	4·3	1·1	78	538	119·9	43·8	1·1	9	2	13	6	—	6·5	16	1·81
BARNSTAPLE (Devon), William Knill, Esq.	43	April	29·942	1·390	66·5	32·0	34·5	59·1	41·1	18·0	49·1	36·8	·220	2·6	1·5	63	545	—	—	1·2	4	10	11	5	—	2·0	9	2·05
		May	29·927	0·910	73·5	37·0	36·5	62·5	47·4	15·1	53·2	46·0	·311	3·5	0·9	77	540	—	—	1·1	6	4	12	9	—	4·0	12	1·59
		June	29·913	0·690	77·0	43·0	29·0	69·1	56·4	12·7	60·4	53·0	·401	4·5	1·2	76	532	—	—	1·1	7	5	10	8	—	4·4	12	2·41
STRATHFIELD TURGISS (Hants), Rev. C. H. Griffith, M.A., F.M.S.	197	April	29·781	1·254	67·4	25·8	41·6	56·9	35·8	21·1	45·9	40·6	·249	2·9	0·8	82	546	108·5	28·6	0·9	6	9	6	9	2·2	5·5	10	1·02
		May	29·759	0·890	76·5	29·2	47·3	63·2	41·6	21·6	51·4	44·9	·298	3·4	0·8	79	539	113·8	37·3	1·9	6	7	6	12	1·7	5·4	11	1·90
		June	29·767	0·659	81·2	36·9	44·3	69·9	47·5	22·4	56·9	51·1	·375	4·2	0·8	81	533	125·1	43·1	1·0	6	6	8	10	2·2	6·2	13	1·77
BATH (Somerset), St. Gregory's College, Downside, Rev. T. J. Almond, O.S.B., F.M.S.	396	April	29·841	1·318	62·3	26·9	35·4	54·4	37·8	17·1	45·0	37·9	·227	2·6	0·8	76	549	107·0	30·9	1·1	7	7	10	6	—	6·0	11	0·99
		May	29·818	1·118	70·0	30·4	39·6	58·1	43·1	15·0	49·3	43·6	·284	3·4	0·6	80	533	112·5	38·7	1·2	10	5	6	10	—	7·2	14	2·02
		June	29·329	0·677	73·9	41·1	32·8	63·8	47·9	15·9	54·6	52·4	·395	4·4	0·3	92	537	122·3	42·9	1·2	9	3	8	10	—	6·2	19	5·86
MARLBOROUGH (Wilts), Rev. Thomas A. Preston, M.A., F.M.S.	456	April	29·488	1·273	65·0	27·1	37·9	55·2	36·6	18·6	45·0	37·9	·227	2·6	0·8	76	548	106·4	33·2	0·7	8	9	6	7	—	5·7	11	0·98
		May	29·458	0·878	71·1	29·1	42·0	59·4	42·5	16·9	50·0	43·2	·278	3·2	0·9	78	535	109·1	39·1	0·7	7	8	7	9	—	6·2	16	2·00
		June	29·466	0·666	78·3	37·2	41·1	66·3	47·9	18·9	56·6	49·5	·355	4·1	1·1	77	528	123·2	44·5	0·7	6	7	9	8	—	6·6	17	1·74
WHITCHURCH RECTORY (Oxon), (near Reading). Rev. J. Slatter, M.A., F.M.S.	150	April	29·872	1·449	67·3	27·3	40·0	58·6	36·2	22·4	47·4	40·4	·251	2·9	0·6	78	547	—	—	0·9	5	8	6	11	—	6·1	7	1·06
		May	29·800	0·870	78·0	29·2	48·8	64·0	41·7	22·3	52·1	44·0	·299	3·4	1·0	79	539	—	—	1·0	9	10	5	7	—	4·8	10	2·22
		June	—	—	80·3	37·0	43·3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	10	1·55
BLACKHEATH (Kent), James Glaisher, Esq., F.R.S.	150	April	29·828	1·245	69·5	31·2	38·3	57·3	39·5	17·8	48·1	37·9	·232	2·7	0·9	74	546	104·9	33·4	0·6	4	9	5	12	—	5·5	10	1·73
		May	29·791	0·873	81·0	32·5	48·5	68·0	45·7	17·3	52·8	44·4	·293	3·3	1·2	74	538	116·2	39·5	0·7	9	5	7	10	—	5·7	10	1·70
		June	29·800	0·641	84·0	42·5	41·5	69·8	51·2	18·6	58·5	49·8	·339	4·1	1·5	73	532	126·1	43·5	0·7	5	5	10	10	—	5·8	14	1·47
ROYAL OBSERVATORY, Greenwich, W. H. M. Christie, M.A., F.R.S., Astronomer Royal.	159	April	29·826	1·240	69·1	28·2	40·9	57·6	37·4	20·2	46·8	39·0	·238	2·7	0·9	75	545	107·8	31·1	—	—	—	—	—	1·7	6·4	10	1·70
		May	29·784	0·877	81·0	30·8	50·7	68·7	43·5	20·2	53·1	45·3	·308	3·4	1·1	76	538	117·8	36·8	—	—	—	—	—	3·0	6·3	9	1·71
		June	29·793	0·643	84·8	40·4	44·4	70·8	48·9	21·9	59·0	51·3	·378	4·3	1·3	76	531	128·1	42·6	—	—	—	—	—	4·6	6·7	18	1·34
CAMDEN SQUARE (London), G. J. Symons, Esq., F.R.S., F.M.S.	123	April	29·868	1·234	66·9	29·3	39·6	58·7	38·9	19·8	47·3	38·1	·230	2·8	1·0	70	546	94·2	35·7	—	18	6	3	8	—	5·9	9	1·56
		May	29·827	0·891	79·6	31·0	48·6	64·8	44·5	20·3	53·1	44·1	·289	3·3	1·2	71	539	100·2	40·7	—	16	5	2	7	—	5·5	11	1·97
		June	29·857	0·665	85·6	41·3	44·3	71·4	50·4	21·0	59·2	49·1	·350	4·0	1·7	70	532	111·2	46·6	—	12	8	4	16	—	5·7	12	1·35
BARNET (Gas Works), T. H. Martin, Esq., C.E.	212	April	29·802	1·232	68·2	22·4	45·8	57·4	35·1	22·3	45·2	38·3	·231	2·7	0·8	77	547	108·9	27·8	0·9	7	10	6	7	—	5·8	9	1·47
		May	29·759	0·864	78·5	29·0	49·5	63·0	40·2	22·8	50·7	42·7	·275	3·2	1·0	75	540	121·6	33·4	0·6	8	10	4	9	—	5·5	9	1·63
		June	29·770	0·648	88·9	35·0	48·9	69·7	46·3	23·4	56·6	48·9	·347	3·9	1·2	76	534	—	39·3	0·5	4	10	6	10	—	6·6	10	1·82
OXFORD (The Observatory), E. J. Stone, Esq., M.A., F.R.S.	210	April	29·775	1·269	65·4	29·8	35·6	56·9	39·6	17·3	47·9	40·5	·252	2·9	0·9	77	543	107·0	33·4	2·4	5	7	8	7	1·9	6·1	10	1·02
		May	29·737	0·868	72·4	30·4	42·0	61·0	44·7	16·3	52·3	45·0	·300	3·4	1·1	76	538	111·5	37·7	2·5	10	5	9	7	3·9	6·0	14	1·88
		June	29·735	0·673	78·0	41·0	37·0	66·9	50·0	16·9	58·1	51·2	·378	4·1	1·2	78	531	119·6	45·3	2·5	9	6	8	7	3·5	6·4	16	3·61
ROYSTON (Hertfordshire), Hale Wortham, Esq., F.R.A.S., F.M.S.	269	April	29·725	1·220	68·8	28·7	40·1	57·8	37·7	20·1	45·7	39·5	·243	2·7	1·0	80	545	—	—	—	9	6	7	8	—	6·3	7	2·07
		May	29·703	0·914	80·4	29·0	51·4	64·0	43·0	21·0	51·5	46·0	·312	3·5	0·7	82	538	—	—	—	11	4	7	9	—	5·9	9	1·90
		June	29·725	0·699	83·1	38·7	44·4	70·3	48·5	21·8	56·8	51·0	·375	4·1	1·0	81	532	—	—	—	9	7	7	7	—	6·0	9	5·11
BEDFORD, Cardington, Mr. J. McLaren, Assistant to S. Whitbread, Esq., M.P.	105	April	29·911	1·250	70·4	25·0	45·4	57·8	36·7	21·1	46·0	38·3	·233	2·7	0·9	75	548	87·7	33·9	1·0	12	5	5	8	—	5·8	9	1·90
		May	29·867	0·884	79·0	26·6	52·4	69·7	42·4	21·3	52·0	43·9	·287	3·3	1·1	74	541	96·0	40·8	1·1	12	6	5	8	—	6·1	9	1·88
		June	29·875	0·656	85·6	38·4	47·2	70·4	48·1	22·3	57·9	49·9	·360	4·2	1·4	74	534	111·5	46·0	0·8	8	5	8	9	—	5·8	8	2·70
CAMBRIDGE (Trinity College), J. W. L. Glaisher, Esq., M.A., F.R.S.	40	April	29·947	1·246	70·1	23·0	47·1	58·8	36·8	22·0	46·2	40·0	·248	2·9	0·8	80	548	118·9	31·5	1·0	5	9	7	9	—	6·3	12	2·29
		May	29·887	0·872	81·5	28·5	53·0	64·8	42·4	22·4	51·8	45·6	·307	3·4	0·9	79	541	129·8	36·8	1·0	7	4	9	11	—	5·3	9	1·09
		June	29·901	0·672	85·7	37·8	47·9	71·2	48·0	23·2	57·4	51·3	·379	4·3	1·0	80	535	142·7	45·6	1·0	3	10	7	10	—	5·4	13	5·23

Names of Stations and Observers.	Height of Station above Sea Level.	Year 1883.	Pressure of Atmosphere in Month.		Temperature of Air in Month.						Mean Temperature.		Vapour.			Mean Degree of Humidity. Sat. = 100.	Mean Weight of a cubic foot of Air.	Mean Reading of Thermometer.		Wind.					Mean Amount of Ozone.	Mean Amount of Cloud.	Rain.	
								Mean						In a cubic foot of Air.				Maximum in Rays of Sun.	Minimum on Grass.	Estimated Strength.	Relative Proportion of						Number of Days it fell.	Amount collected.
		Months.	Mean.	Range.	Highest.	Lowest.	Range.	Of all Highest.	Of all Lowest.	Daily Range.	Air.	Dew Point.	Elastic Force.	Mean.	Short of Saturation.					N.	E.	S.	W.				
	feet.		in.	in.	°	°	°	°	°	°	°	°	in.	grs.	gr.		grs.	°	°								in.
RUGBY (Warwickshire), Stockton, The Rectory, Rev. W. Tuckwell.	289	April	29·579	1·162	68·0	24·0	42·0	56·7	36·7	20·0	45·6	39·3	·242	2·7	0·7	79	543	—	—	0·6	6	9	8	7	6·9	6·8	11	1·31
		May	29·545	0·824	74·5	28·0	46·5	60·4	41·2	19·2	49·9	44·1	·289	3·3	0·8	82	537	—	—	0·6	11	4	10	6	6·5	5·9	14	2·33
		June	29·545	0·646	80·2	36·5	43·7	68·3	46·9	21·4	58·4	50·6	·369	4·1	1·0	81	530	—	—	0·5	8	7	9	6	3·2	7·0	15	3·16
LOWESTOFT (Suffolk), S. H. Miller, Esq., F.R.A.S., F.M.S.	89	April	29·897	1·223	59·0	27·9	31·1	53·3	38·5	14·8	44·9	40·4	·251	2·9	0·5	85	549	99·7	34·8	0·4	6	12	7	5	—	7·0	10	1·96
		May	29·840	0·930	76·0	32·0	44·0	53·6	43·5	10·1	48·7	43·0	·276	3·2	0·9	81	544	105·8	40·3	0·4	8	3	5	15	—	5·9	12	1·90
		June	29·868	0·624	77·0	41·3	35·7	61·5	49·7	11·8	54·7	48·6	·340	3·9	1·1	80	538	110·4	46·8	0·6	5	10	11	4	—	6·9	12	2·16
SOMERLEYTON (Suffolk), The Rectory, Rev. C. J. Steward, F.M.S.	50	April	29·936	1·256	63·2	27·3	35·9	53·8	37·3	15·5	43·7	38·5	·233	2·6	0·6	81	551	—	—	1·0	6	12	8	4	5·9	4·6	8	1·87
		May	29·882	0·854	75·2	32·0	43·2	59·2	43·2	16·0	49·6	45·0	·301	3·4	0·6	84	543	—	—	0·9	9	10	7	7	4·6	4·6	11	1·54
		June	29·911	0·692	77·3	40·8	36·5	63·3	48·8	14·5	54·6	52·6	·383	4·3	0·5	87	538	—	—	1·0	6	13	6	5	4·7	5·5	11	2·28
WOLVERHAMPTON (Staffordshire), Wrottesley, E. Simpson, Esq.	500	April	29·497	1·224	62·4	27·7	34·7	55·0	35·6	19·4	43·7	37·4	·223	2·3	0·4	78	535	—	—	—	5	10	8	7	—	6·4	8	0·86
		May	29·443	0·846	74·5	26·8	47·7	59·2	40·9	18·3	48·7	39·9	·247	2·8	1·2	72	536	—	—	—	9	7	8	7	—	7·5	13	1·45
		June	29·458	0·732	74·2	37·4	36·8	64·6	46·7	17·9	53·8	47·5	·337	4·7	0·9	80	531	—	—	—	8	9	7	6	—	7·6	15	3·24
LEICESTER (Town Museum), J. C. Smith, Esq.	238	April	29·729	1·297	66·9	27·0	39·9	56·5	33·3	18·2	46·5	38·6	·276	2·5	0·7	74	544	97·9	29·7	0·5	8	9	7	6	—	6·0	11	2·18
		May	29·684	0·878	76·8	31·6	45·2	61·1	43·4	17·7	51·6	43·6	·284	3·1	1·2	76	538	109·1	38·0	0·5	12	4	8	9	—	6·3	13	2·28
		June	29·695	0·722	80·7	41·0	39·7	67·8	48·7	19·1	57·0	49·3	·351	3·9	1·3	75	531	115·5	39·1	0·6	8	6	7	9	—	6·8	15	3·91
NOTTINGHAM (Notts), M.O.Tarbotton, Esq.,C.E.,F.G.S., F.M.S.	183	April	29·794	1·250	66·8	24·8	42·0	57·1	37·4	19·7	46·1	38·0	·230	2·6	1·0	74	546	89·1	35·7	0·2	2	12	10	6	1·2	6·4	14	2·24
		May	29·733	0·858	81·4	33·0	48·4	63·4	42·4	21·0	51·5	43·0	·278	3·1	1·2	73	538	99·3	40·8	0·3	9	4	8	10	2·5	5·7	14	1·80
		June	29·745	0·710	87·7	39·0	48·7	69·5	47·9	21·6	57·0	48·7	·344	3·8	1·4	73	532	108·0	45·9	0·2	6	9	9	6	2·4	6·1	9	4·02
BURSLEM, J. E. Worth, Esq., C.E.	556	April	29·389	1·254	63·3	26·2	37·1	55·1	37·9	17·2	45·5	38·0	·229	2·7	0·8	75	539	—	—	0·9	6	8	6	10	—	6·3	9	1·51
		May	29·340	0·849	71·6	30·4	41·2	59·3	42·4	17·4	49·8	42·2	·220	3·1	1·0	75	532	—	—	0·8	9	4	10	8	—	6·5	17	1·14
		June	29·354	0·736	72·3	40·6	31·7	64·9	47·5	17·4	54·7	47·1	·323	3·7	1·2	75	528	—	—	0·8	6	7	9	8	—	7·9	18	3·20
LLANDUDNO (Carnarvonshire), James Nicol, Esq., M.D.	100	April	29·886	1·370	62·4	32·5	29·9	52·9	39·6	13·3	46·2	38·1	·231	2·7	0·8	74	547	—	—	0·9	3	8	10	9	—	5·5	9	0·83
		May	29·847	0·770	65·3	38·5	26·8	56·1	45·1	11·0	50·0	42·4	·271	3·1	1·0	70	542	—	—	1·1	5	10	3	18	—	6·5	6	1·42
		June	29·849	0·870	70·0	44·8	25·2	62·2	50·7	11·5	55·4	48·5	·344	3·8	1·1	78	536	—	—	0·9	6	5	9	10	—	5·9	11	1·70
LIVERPOOL, The Observatory, John Hartnup, Esq., F.R.A.S.	197	April	29·772	1·370	61·2	34·3	26·9	53·3	40·9	12·4	46·0	37·6	·227	2·6	1·0	74	545	—	—	—	2	13	5	10	—	5·7	8	0·83
		May	29·735	0·869	65·0	34·4	30·6	57·4	44·8	12·6	49·3	41·6	·264	3·0	1·1	74	541	—	—	—	7	6	6	12	—	5·8	12	0·78
		June	29·740	0·689	74·9	43·5	31·4	62·8	50·2	12·6	55·0	47·4	·327	3·7	1·2	76	545	—	—	—	1	9	7	13	—	6·4	14	2·22
BOLTON, Sharples (Lancashire), Rev.T. Mackereth,F.R.A.S.,F.M.S.	500	April	29·450	1·287	59·8	28·1	31·7	53·9	37·0	16·9	44·5	37·2	·222	2·6	0·8	74	541	67·6	29·6	1·4	6	10	7	7	2·5	5·9	9	2·38
		May	29·408	0·872	68·0	30·9	37·1	57·2	40·9	16·3	48·3	40·5	·252	2·9	1·0	75	536	73·6	34·4	2·2	9	6	6	10	3·5	6·8	13	0·94
		June	29·421	0·796	74·2	38·8	35·4	63·5	47·0	16·5	53·9	47·0	·323	3·6	1·1	77	530	80·8	40·8	1·0	7	7	8	8	3·5	7·3	17	4·21
HALIFAX, Bermerside Observatory (Yorkshire), E. J. Crossley, Esq., F.R.A.S.	580	April	29·466	1·216	65·0	28·4	36·6	54·5	36·9	17·6	43·9	36·7	·208	2·5	0·8	75	542	88·0	33·0	0·7	6	8	7	9	—	6·6	10	2·80
		May	29·417	0·902	73·8	30·7	43·1	59·6	40·3	19·3	43·6	40·1	·248	2·8	1·1	72	536	100·1	36·8	0·9	6	6	8	11	—	6·3	12	1·04
		June	29·439	0·750	77·0	39·7	37·3	65·3	46·5	18·8	54·1	46·0	·309	3·5	1·2	73	530	104·1	43·5	0·7	5	7	8	10	—	7·1	15	3·91
HULL (Yorkshire), The People's Park, Mr. E. Peak.	12	April	29·991	1·214	65·0	28·0	37·0	54·5	36·2	18·3	45·2	36·4	·212	2·5	1·0	78	551	78·2	35·1	1·3	1	11	13	5	—	6·4	13	1·78
		May	29·921	0·840	79·0	32·0	47·0	61·5	40·6	20·9	50·6	42·2	·269	3·0	1·0	73	543	88·8	39·9	1·5	6	9	8	8	—	5·5	14	2·00
		June	29·935	0·692	79·0	37·0	42·0	67·0	47·5	19·5	56·2	46·9	·323	3·6	1·1	73	537	88·4	46·7	1·3	6	8	9	7	—	7·6	9	2·95
STONYHURST (Lancashire), Rev. S. J. Perry, F.R.S., F.M.S., F.R.A.S.	353	April	29·606	1·213	61·8	29·0	32·8	55·8	36·4	19·4	44·8	38·3	·232	2·7	0·7	76	544	106·6	34·5	—	5	9	6	10	—	6·4	11	2·03
		May	29·561	0·809	70·0	27·0	43·0	59·7	40·2	19·4	48·8	41·3	·261	3·0	1·0	76	538	117·5	39·1	—	6	5	3	7	—	7·3	9	1·05
		June	29·559	0·812	75·9	40·2	35·7	66·3	46·3	20·0	54·2	46·9	·330	3·6	1·1	76	532	121·8	45·5	—	2	8	9	11	—	7·9	14	4·31
BRADFORD (Yorkshire), J. McLandsborough, Esq., C.E., F.G.S.	366	April	29·583	1·484	63·8	32·1	31·7	53·7	39·2	14·5	45·5	36·9	·221	2·8	0·5	85	543	72·5	—	0·9	2	6	4	18	—	6·5	9	2·64
		May	29·534	0·890	71·6	33·0	38·6	58·8	43·7	15·1	49·8	40·7	·255	2·9	1·2	71	537	81·0	—	1·0	7	7	5	12	—	5·8	13	0·58
		June	29·548	0·756	75·0	44·0	31·0	64·3	49·9	14·4	55·2	46·0	·312	3·5	1·4	71	531	84·9	—	0·8	3	11	8	8	—	6·9	20	3·51

Names of Stations and Observers.	Height of Station above Sea Level.	Year 1883. Months.	Pressure of Atmosphere in Month. Mean.	Range.	Temperature of Air in Month. Highest.	Lowest.	Range.	Mean of all Highest.	Mean of all Lowest.	Mean Daily Range.	Mean Temperature. Air.	Dew Point.	Vapour. Elastic Force.	In a cubic foot of Air. Mean.	Short of Saturation.	Mean Degree of Humidity. Satn. = 100.	Mean Weight of a cubic foot of Air.	Mean Reading of Thermometer. Maximum in Rays of Sun.	Minimum on Grass.	Wind. Estimated Strength.	Relative Proportion o N.	E.	S.	W.	Mean Amount of Ozone.	Mean Amount of Cloud.	Rain. Number of Days it fell.	Amount collected.
	feet.		in.	in.	°	°	°	°	°	°	°	°	in.	grs.	gr.		grs.	°	°								in.	
LEEDS (Yorkshire), The Philosophical Hall, Henry Crowther, Esq.	137	April	29·833	1·292	65·0	31·0	34·0	55·6	39·6	16·0	46·5	41·0	·258	3·1	0·6	82	546	—	—	1·1	6	9	5	10	—	6·9	11	2·85
		May	29·783	0·874	74·0	34·0	40·0	60·4	43·8	16·6	51·0	44·7	·297	3·4	0·8	79	540	—	—	1·2	7	5	4	15	—	5·8	9	0·91
		June	29·800	0·764	79·0	44·0	35·0	67·4	49·8	17·6	55·7	51·8	·386	4·3	0·5	87	535	—	—	1·1	—	—	4	10	7·9	7·0	13	3·42
LANCASTER (Southfields), William Roper, Esq.	114	April	29·854	1·456	61·0	28·0	33·0	53·9	37·0	16·9	45·4	39·0	·268	2·7	0·7	79	547	—	—	—	—	—	—	—	—	—	8	1·90
		May	29·809	0·794	67·0	32·0	35·0	58·3	41·0	17·3	48·6	40·0	·248	2·7	1·1	72	543	—	—	—	—	—	—	—	—	—	11	1·26
		June	29·784	0·668	71·0	41·0	30·0	64·3	47·7	16·6	55·6	45·7	·310	3·5	1·5	70	535	—	—	—	—	—	—	—	—	—	11	3·70
SILLOTH (Cumberland), "The Rectory," Rev. F. Redford, M.A., F.R.A.S., F.M.S.	28	April	29·957	1·290	60·0	28·4	31·6	53·1	37·0	16·1	44·4	37·8	·228	2·7	0·8	77	551	100·3	34·3	1·3	4	12	5	9	7·2	5·4	13	1·78
		May	29·901	0·926	64·4	29·9	34·5	56·7	41·3	15·4	48·3	41·4	·261	3·0	0·9	77	545	111·0	38·3	1·8	8	5	5	13	7·6	4·8	12	1·21
		June	29·913	0·907	72·5	37·3	35·2	63·3	46·8	16·5	53·7	47·2	·323	3·7	0·8	78	539	114·2	44·0	1·2	2	10	5	13	8·3	5·6	13	2·58
CARLISLE, Spital (Cumberland), Isaac Cartmel, Esq., F.M.S.	114	April	29·855	1·322	62·8	25·8	37·0	55·1	36·1	19·0	44·8	38·7	·235	2·7	0·8	79	548	89·5	28·1	0·9	2	12	5	12	4·2	7·8	9	1·90
		May	29·803	0·912	69·0	25·8	43·2	60·0	38·8	21·2	48·2	42·8	·274	3·1	0·7	82	543	99·0	30·1	1·0	5	8	6	12	3·1	7·8	11	0·94
		June	29·815	0·890	76·8	32·8	44·0	66·7	45·0	21·7	54·0	48·1	·334	3·8	0·9	80	538	104·5	37·7	0·9	5	8	4	13	3·6	7·8	13	2·86

Second Rain-gauges are placed—

			January.		February.		March.		April.		May.		June.		Total in Quarter.	
At Eastbourne, at the height of	160	feet *above the sea*; the amount collected was	—	inches.	—	inches.	0·80	inches.	1·73	inches.	—	inches.	—	inches.	—	inches.
,, Beachy Head,	515	,,	1·89	,,	2·51	,,	0·43	,,	1·17	,,	—	,,	—	,,	—	,,
,, ,, ,,	495	,,	1·96	,,	3·04	,,	0·66	,,	1·45	,,	—	,,	—	,,	—	,,
,, Oxford,	22	,, *ground*	—	,,	—	,,	—	,,	0·99	,,	1·85	,,	3·68	,,	6·52	,,
,, Cardington,	21	,,	—	,,	—	,,	—	,,	1·84	,,	1·70	,,	2·64	,,	6·18	,,
,, Nottingham,	39	,,	—	,,	—	,,	—	,,	2·26	,,	1·72	,,	3·92	,,	7·90	,,

Fog prevailed in April, on the 2nd at Torquay; on the 3rd at Guernsey, Torquay, and Stonyhurst; on the 4th at Guernsey, Torquay, Marlborough; on the 5th at Guernsey, Torquay; on the 6th at Carlisle; on the 7th at Cambridge, Wolverhampton, and Hull; on the 8th at Rugby and Hull; on the 11th at Guernsey and Stonyhurst; on the 12th and 13th at Stonyhurst; on the 14th at Cambridge and Stonyhurst; and on the 19th at Wolverhampton.

In May, on the 8th at Wolverhampton and Llandudno; on the 14th at Guernsey; on the 15th at Guernsey and Torquay; on the 20th at Llandudno; on the 21st at Bolton; on the 23rd at Guernsey; and on the 24th, 25th, and 29th at Guernsey.

In June, on the 2nd at Guernsey, Ventnor, and Blackheath; on the 4th and 6th at Guernsey; on the 7th at Guernsey, Torquay, and Wolverhampton; on the 8th at Guernsey, Totnes, Torquay, and Wolverhampton; on the 9th at Truro and Wolverhampton; on the 10th at Guernsey, Totnes, Strathfield Turgiss; on the 12th at Totnes; on the 23rd at Guernsey and Torquay; on the 24th and 25th at Torquay; on the 28th and 29th at Torquay; and on the 30th at Wolverhampton.

NAMES OF STATIONS.	Mean Pressure of dry Air reduced to the level of the Sea.	Highest Reading of the Thermometer.	Lowest Reading of the Thermometer.	Range of Temperature in the Quarter.	Mean of all Highest.	Mean of all Lowest.	Mean Monthly Range of Temperature.	Mean Daily Range of Temperature.	Mean Temperature of the Air.	Mean Temperature of the Dew Point.	Mean Elastic Force of Vapour.	Mean Weight of Vapour in a cubic foot of Air.	Mean additional Weight required for saturation.	Mean degree of Humidity.	Mean Weight of a cubic foot of Air.	Mean Reading of Maximum in Rays of Sun.	Mean Reading of Minimum on Grass.	Wind. Mean Estimated Strength.	Wind. Relative Proportion of N.	Wind. Relative Proportion of E.	Wind. Relative Proportion of S.	Wind. Relative Proportion of W.	Mean Amount of Ozone.	Mean Amount of Cloud.	Rain. Number of Days on which it fell.	Rain. Amount collected.
	in.	°	°	°	°	°	°	°	°	°	in.	grs.	gr.		grs.	°	°									in
Guernsey	29·861	72·2	32·8	39·4	57·7	46·1	30·7	11·6	50·8	46·6	·324	3·7	0·6	86	539	108·8	41·2	0·7	11	5	7	7	2·7	5·5	40	6·56
Truro	29·849	78·0	28·0	50·0	61·2	43·3	40·3	17·9	49·8	44·4	·300	3·4	0·6	82	543	—	—	2·4	6	7	8	10	—	6·8	40	6·34
Plymouth	29·859	74·5	34·5	40·0	59·8	44·7	31·7	13·1	52·0	49·6	·321	3·6	0·7	82	541	—	—	1·3	5	10	9	6	—	6·4	38	6·44
Totnes	29·867	74·7	27·6	47·1	61·2	41·8	35·7	19·4	50·9	44·2	·307	3·1	0·9	79	542	—	—	1·7	8	8	8	6	—	6·0	43	8·07
Torquay	29·893	72·8	33·1	39·7	58·5	44·1	31·8	14·1	50·4	44·0	·292	3·3	0·9	79	538	115·4	36·0	1·3	8	8	6	8	5·2	6·9	42	6·30
Ventnor	29·852	73·5	32·3	41·2	59·9	46·3	31·3	13·6	51·3	46·5	·322	3·7	0·7	85	542	—	—	1·3	9	8	6	8	6·2	5·7	31	5·54
Osborne	29·850	79·8	30·5	48·8	63·8	43·7	39·4	20·1	51·9	47·5	·335	3·8	0·7	85	539	119·7	41·1	0·1	7	6	10	8	—	4·8	30	4·97
Southbourne	29·865	76·1	30·2	45·9	58·7	43·9	36·8	14·8	50·5	45·8	·320	3·3	0·9	78	542	—	—	1·3	10	6	9	5	—	4·9	32	5·13
Brighton	29·718	79·0	31·0	48·0	61·6	45·0	36·4	16·6	52·1	44·5	·262	3·4	1·1	76	538	104·7	39·8	1·0	7	7	8	8	—	6·0	31	4·10
Salisbury	29·666	84·0	24·5	59·5	65·5	39·8	47·5	25·7	51·6	45·6	·308	3·6	0·9	80	539	115·3	37·5	1·1	8	7	10	6	—	6·4	42	4·95
Barnstaple	29·632	77·0	32·0	45·0	63·6	48·3	33·3	15·8	54·2	48·6	·311	3·5	1·2	72	539	—	—	1·1	6	6	11	7	—	3·5	33	6·05
Strathfield Turgiss	29·673	81·2	25·8	55·4	63·3	41·6	41·4	21·7	51·4	45·5	·307	3·5	0·8	81	539	115·8	36·3	1·3	6	7	7	10	2·0	5·7	34	4·69
Bath	29·665	73·9	28·9	45·0	58·8	42·8	35·3	16·0	49·6	44·6	·302	3·6	0·6	82	540	118·9	37·5	1·2	9	5	8	9	—	6·5	44	8·87
Marlborough	29·672	78·3	27·1	51·2	60·5	42·3	40·3	18·1	50·5	43·5	·287	3·3	0·9	77	535	112·9	39·0	0·7	7	8	7	8	—	6·2	44	4·67
Blackheath	29·678	84·0	31·2	52·8	63·4	45·5	42·8	17·9	52·5	44·0	·295	3·4	1·2	74	539	115·7	38·8	0·7	6	6	7	11	—	5·7	34	4·90
Royal Observatory	29·666	84·8	28·2	56·6	64·0	43·3	45·3	20·8	53·0	45·2	·306	3·5	1·1	76	538	117·9	36·7	—	—	—	—	—	3·4	6·5	32	4·75
Camden Square	29·685	85·6	29·3	56·3	65·0	44·6	44·2	20·4	53·2	43·8	·290	3·4	1·3	70	539	101·9	41·0	—	14	6	3	7	—	5·7	32	4·88
Barnet	29·719	83·9	32·4	51·5	63·4	40·5	48·1	22·8	50·8	43·8	·284	3·3	1·3	76	540	—	33·5	0·7	6	10	5	9	—	6·0	28	4·92
Oxford	29·664	78·0	29·8	48·2	61·6	44·8	38·2	16·8	52·8	45·6	·310	3·5	1·1	77	537	112·7	38·8	2·5	9	6	8	7	2·8	6·2	40	6·51
Royston	29·696	83·1	28·7	54·4	64·0	43·1	45·8	20·9	51·3	45·5	·310	3·4	0·9	81	538	—	—	—	10	6	7	8	—	6·1	25	3·38
Bedford	29·698	85·6	25·0	60·6	64·0	42·4	48·3	21·6	52·0	44·0	·293	3·4	1·1	74	541	98·4	40·2	1·0	11	5	6	8	—	5·9	26	6·48
Cambridge	29·644	85·7	23·0	62·7	64·9	42·4	49·3	22·5	54·8	45·6	·311	3·5	0·9	80	541	130·5	37·3	1·0	5	8	8	10	—	5·7	34	8·61
Rugby	29·598	80·2	24·0	56·2	61·8	41·6	44·1	20·2	50·6	44·7	·300	3·4	0·8	81	537	—	—	0·6	8	7	9	6	5·5	6·6	40	6·89
Lowestoft	29·674	77·0	27·9	49·1	58·1	43·9	36·9	12·2	49·4	44·0	·259	3·3	0·8	82	544	105·1	40·6	0·5	6	8	8	8	—	6·6	34	6·02
Somerleyton	29·658	77·3	27·8	50·0	58·4	43·1	33·5	15·3	49·3	45·4	·306	3·4	0·6	84	544	—	—	1·0	7	12	6	5	5·1	4·9	30	5·69
Wolverhampton	29·735	74·5	28·8	47·7	59·6	41·1	30·7	18·5	48·7	41·6	·266	2·9	0·8	77	534	—	—	—	7	9	8	7	—	7·2	36	5·55
Leicester	29·661	80·7	27·0	53·7	61·8	43·5	41·6	18·3	51·7	43·8	·304	3·2	1·1	75	538	107·5	34·9	0·5	9	6	7	8	—	6·4	39	8·02
Nottingham	29·619	87·7	24·8	62·9	63·3	42·6	46·4	20·8	51·5	43·2	·284	3·2	1·2	73	539	99·8	40·8	0·2	6	8	9	7	2·0	6·1	37	8·06
Burslem	29·676	72·3	30·2	46·1	59·9	42·6	36·7	17·3	50·0	42·4	·274	3·2	1·0	75	533	—	—	0·3	7	6	8	9	—	6·9	44	5·85
Llandudno	29·680	70·0	32·5	37·5	57·1	45·1	27·3	12·0	50·5	43·0	·282	3·2	1·0	74	542	—	—	1·0	5	8	7	11	—	6·0	26	3·95
Liverpool	29·687	74·9	34·3	40·6	57·8	45·3	29·6	12·5	50·3	42·2	·273	3·1	1·1	75	543	—	—	1·3	3	9	6	12	—	6·0	34	3·83
Bolton	29·712	74·2	28·1	46·1	58·2	41·0	34·7	16·6	48·9	41·6	·269	3·0	1·0	75	536	74·0	34·9	1·5	7	8	7	8	3·2	6·1	39	7·63
Halifax	29·742	77·0	28·4	48·6	59·8	41·2	39·0	18·6	48·9	40·9	·255	2·9	1·0	73	536	97·4	37·8	0·8	6	7	8	10	—	5·7	37	7·75
Hull	29·695	79·0	28·0	51·0	61·0	41·4	42·0	19·6	50·7	41·8	·263	3·0	1·0	73	544	85·1	40·6	1·4	4	9	10	7	—	6·5	36	6·73
Stonyhurst	29·693	75·9	27·0	48·9	60·6	41·0	37·2	19·6	49·3	42·2	·271	3·1	0·9	76	538	115·3	30·7	—	4	7	6	9	—	7·2	34	8·39
Bradford	29·699	75·0	28·1	42·9	58·9	44·3	33·8	14·7	50·2	41·2	·265	3·1	1·0	76	537	79·5	—	0·9	4	8	6	13	—	6·4	42	6·73
Leeds	29·641	79·0	31·0	48·0	61·1	44·4	36·3	16·7	51·1	45·8	·314	3·9	0·6	85	540	—	—	1·1	6	8	5	11	—	6·6	33	7·18
Lancaster	29·665	71·0	28·0	43·0	59·8	41·9	32·7	16·9	49·9	41·6	·266	3·0	1·1	74	542	—	—	—	—	—	—	—	—	—	30	6·86
Silloth	29·683	72·5	28·4	44·1	57·7	41·7	33·8	16·0	48·8	42·1	·271	3·1	0·8	77	545	108·5	38·9	1·4	5	9	5	12	7·7	5·3	39	5·57
Carlisle	29·665	76·8	25·8	51·0	60·6	40·0	41·4	20·6	49·0	43·2	·281	3·2	0·7	80	540	97·1	32·0	0·9	4	9	5	12	3·6	7·5	33	5·70

The highest temperatures of the air were at Nottingham, 87°·7; at Cambridge, 85°·7; and at Camden Square and Bedford, 85°·6.
The lowest temperatures of the air were at Barnet, 22°·4; at Cambridge, 23°·0; and at Rugby, 24°·0.
The greatest ranges of temperature were at Salisbury, 25°·7; at Barnet, 23°·8; and at Cambridge, 22°·5.
The least daily ranges of temperature were at Guernsey, 11°·6; at Llandudno, 12°·0; and at Lowestoft, 12°·2.
The greatest number of days of rain were at Marlborough, Burslem, and Bath 44; at Totnes, 43; and at Torquay, Salisbury, and Bradford, 42.
The least number of days of rain were at Royston, 25; at Bedford, Bath, and Llandudno, 26; and at Barnet, 28.
The greatest falls of rain were at Bath, 8·87 inches; Cambridge, 8·61 inches; and at Stonyhurst, 8·39 inches.
The least falls of rain were at Liverpool, 3·83 inches; at Llandudno, 3·95 inches; and at Brighton, 4·10 inches.

Quarterly Meteorological Table for different Parallels of Latitude.

PARALLELS OF LATITUDE, &c.	Mean Pressure of dry Air reduced to the level of the sea.	Mean of all Highest Readings of the Thermometer.	Mean of all Lowest Readings of the Thermometer.	Mean Range of Temperature in the Quarter.	Mean of all Highest.	Mean of all Lowest.	Mean Monthly Range of Temperature.	Mean Daily Range of Temperature.	Mean Temperature of the Air.	Mean Temperature of the Dew Point.	Mean Elastic Force of Vapour.	Mean Weight of Vapour in a cubic foot of Air.	Mean additional Weight required for saturation.	Mean degree of Humidity.	Mean Weight of a cubic foot of Air.	Mean Reading of Maximum in Rays of Sun.	Mean Reading of Minimum on Grass.	Wind. Mean Estimated Strength.	Wind. Relative Proportion of N.	Wind. Relative Proportion of E.	Wind. Relative Proportion of S.	Wind. Relative Proportion of W.	Mean Amount of Ozone.	Mean Amount of Cloud.	Rain. Mean Number of Days it fell.	Rain. Mean Amount collected.
	in.	°	°	°	°	°	°	°	°	°	in.	grs.	gr.		grs.	°	°									in.
Guernsey	29·661	72·2	32·8	39·4	57·7	46·1	30·7	11·6	50·8	46·6	·324	3·7	0·6	86	539	108·8	41·2	0·7	11	5	7	7	2·7	5·5	40	6·56
Between 50° and 51°	29·669	75·9	30·9	45·1	60·6	44·4	35·4	16·2	51·1	45·1	·301	3·4	0·8	81	541	113·3	39·0	1·3	7	8	8	7	5·7	5·8	36	5·70
Between 51° and 52°	29·676	81·1	27·9	53·2	62·9	43·4	41·9	19·6	52·0	45·5	·301	3·5	1·0	77	539	113·3	36·9	1·2	8	7	7	8	2·7	5·8	36	5·76
the 52° and 53°	29·668	80·4	26·1	54·3	61·8	42·6	42·7	18·7	50·6	44·0	·294	3·4	0·9	78	539	106·1	38·8	0·7	8	8	8	7	4·3	6·2	35	6·15
latitudes 53° and 54°	29·690	75·1	29·9	45·2	59·2	42·9	34·8	16·4	50·0	42·8	·273	3·1	0·9	75	540	90·8	38·3	1·1	4	8	7	10	—	6·5	35	5·76
54° and 55°	29·674	74·7	27·1	47·6	59·2	40·8	37·6	18·3	48·9	42·7	·276	3·1	0·8	79	543	103·1	35·5	1·2	5	9	5	12	5·7	6·4	36	5·64
Mean for the Quarter, 50° to 55° Year 1880	29·661	76·0	31·5	44·5	59·9	43·8	35·7	16·1	50·6	44·4	·297	3·5	0·8	80	539	104·0	38·5	1·2	7	8	6	9	4·6	6·4	41	5·94
" 1881	29·705	78·6	28·5	51·9	61·0	43·1	41·8	17·9	51·0	45·9	·294	3·3	1·0	77	541	107·2	38·9	1·2	6	9	6	10	4·2	6·9	36	5·32
" 1882	29·583	73·6	29·9	43·7	60·8	43·9	34·8	16·7	51·1	44·8	·303	3·4	0·9	78	539	106·5	38·6	1·2	5	8	7	10	4·7	6·1	47	8·05
" 1883	29·673	77·4	28·8	49·1	60·6	42·7	38·6	17·9	50·5	43·7	·289	3·3	0·9	78	539	106·5	37·8	1·1	7	8	7	9	4·6	6·2	35	5·11

METEOROLOGY OF ENGLAND,

DURING THE QUARTER ENDING SEPTEMBER 30, 1883.

REMARKS ON THE WEATHER DURING THE QUARTER ENDING SEPTEMBER 30TH, 1883.

By JAMES GLAISHER, ESQ., F.R.S., *&c.*

The weather in July was generally fine and warm till the 10th day, followed by cold unsettled weather during the remainder of the month; between the 14th and 23rd day the weather was particularly cold. The sky was generally obscured by clouds. Upon the whole the month was cold with rain a little above the average amount. The hay harvest was very much checked, but many crops were benefited by the rain.

The weather in August was cold at the beginning and warm generally from the 13th day, with a rain-fall less than the average and a high barometer reading. It was a fine month for harvest work, and the bright sunshine after the middle of the month was favourable for ripening the green crops. The month was nearly free from thunderstorms.

The weather in September was rather cold at the beginning of the month, followed by a warm period which extended nearly to the end. The fall of rain was above the average at most stations. The harvest at all southern stations was gathered in good condition, but, at northern stations, the severe gales of wind on the 23rd and 25th days, interfered with harvest operation and in some places the crop was injured. There were very few thunderstorms in the month.

About London the mean daily temperature of the air was above its average until the 4th day, the mean excess being 4°·7, then the 5th was below by 1°·2, for 4 days the temperature was above its average by 1°·4 daily, then followed a cold period of 39 days and the mean deficiency was 3°·8; this was followed by a warm period of 13 days, the daily excess being 2°·8; from August 31st to September 11th, the deficiency was 2°·8 daily, and from September 12th to the end of the quarter the mean daily excess was 1°·7.

The mean temperature of the air for July was 59°·9, being 1°·8 and 2°·3 below the averages of 112 years, and 42 years respectively; it was 0°·5, 5°·5, 1°·8 lower than in 1882, 1881, and 1880 respectively.

The mean temperature for August was 61°·9, being 1°·0 and 0°·6 above the averages of 112 years and 42 years respectively; it was 2°·3 and 2°·8 higher than in 1882 and 1881 respectively, and 0°·9 lower than in 1880.

The mean temperature for September was 56°·8, being 0°·3 above the averages of 112 years, and 0°·3 below the average of 42 years; it was 2°·5, and 1°·4 higher than in 1882 and 1881 respectively, and 2°·9 lower than in 1880.

The mean temperature for the quarter was 59°·5 being 0°·2 and 0°·7 below the averages of 112 years and 42 years respectively.

The mean high day temperature of the air in July was 70°·6, being 3°·6 lower than the average of 42 years; in August it was 74°·0, being 1°·2 higher than the average, and in September was 66°·4, being 1°·0 below the average.

The mean low night temperature of the air in July was 51°·3, being 1°·9 below the average of 42 years; in August it was 52°·8, being 0°·4 below the average; and in September it was 49°·7, being 0°·6 above the average.

Therefore both the high day temperatures and low night temperatures were cold in July, the high day temperatures were warm and the nights cold in August, and the days cold and the nights warm in September.

The mean daily range of temperature in July was 1°·7 less than the average, in August it was 1°·6 greater than the average, and in September it was 1°·6 smaller than the average.

The mean temperature of the air in July was 0°·9 higher than in June; in August it was 2°·0 higher than July, and in September it was 5°·1 lower than in August.

(From the preceding 42 years' observations the increase of temperature from June to July is 3°·3; the decrease of temperature from July to August is 0°·9, and the decrease from August to September is 4°·2.)

From June to July there was an increase of temperature at stations south of 51° of 2°·0, between 51° and 52° of 0°·8, between 52° and 53° of 1°·5, between 53° and 54° of 1°·8, and between 54° and 55° of 2°·3.

From July to August there was an increase of temperature at stations south of 51° of 2°·0, between 51° and 52° of 1°·9, between 52° and 53° of 1°·8, between 53° and 54° of 1°·7, and between 54° and 55° of 0°·4.

From August to September there was a decrease of temperature south of 51° of 3°·1, between 51° and 52° of 4°·9, between 52° and 53°of 3°·6, between 53°and 54°of 3°·2, and between 54° and 55° of 2·6.

About London the mean daily pressure of the atmosphere was above its average for the first two days, from the 3rd to the 15th it was below the daily deficiency being 0·17 in.; the 16th and 17th days were above, then from the 18th till the 24th, it was below its average, and the daily deficiency was 0·18 in., this was followed by four days above the daily excess being 0·16 in. From July 29th to the 31st the daily deficiency was 0·17 in. From August 1st to 5th there was a mean daily excess of 0·23 in., from the 6th the readings were below until the 15th, the average deficiency was 0·09 in., for 12 days the mean daily excess was 0·17 in., on August 28th the

reading passed below the average, and continued so with few exceptions till September 11th; then for 8 days there was an excess of pressure; and from the 20th to the end of the quarter there was a deficiency of 0·27 in. daily.

1883. Months.	Temperature of Air. Mean.	Air. Diff. from average of 112 years.	Air. Diff. from average of 42 years.	Evaporation. Mean.	Evaporation. Diff. from average of 42 years.	Dew Point. Mean.	Dew Point. Diff. from average of 42 years.	Air—Daily Range. Mean.	Air—Daily Range. Diff. from average of 42 years.	Elastic Force of Vapour. Mean.	Elastic Force of Vapour. Diff. from average of 42 years.	Weight of Vapour in a Cubic Foot of Air. Mean.	Weight of Vapour in a Cubic Foot of Air. Diff. from average of 42 years.
	°	°	°	°	°	°	°	°	°	in.	in.	grs.	gr.
July -	59·9	−1·8	−2·3	56·2	−1·5	53·0	−1·0	19·3	−1·7	·402	−0·016	4·5	−0·3
Aug. -	61·9	+1·0	+0·6	57·7	+0·2	54·1	+0·1	21·2	+1·6	·419	0·000	4·6	−0·1
Sept. -	56·8	+0·3	−0·3	54·5	+0·5	53·4	+1·3	16·7	−1·6	·394	+0·015	4·4	0·0
Means -	59·5	−0·2	−0·7	56·1	−0·3	53·2	+0·1	19·1	−0·6	·405	0·000	4·5	−0·1

1883. Months.	Degree of Humidity. Mean.	Degree of Humidity. Diff. from average of 42 years.	Reading of Barometer. Mean.	Reading of Barometer. Diff. from average of 42 years.	Weight of a Cubic Foot of Air. Mean.	Weight of a Cubic Foot of Air. Diff. from average of 42 years.	Rain. Amount.	Rain. Diff. from average of 67 years.	Daily Horizontal movement of the Air.	Reading of Thermometer on Grass. Number of Nights it was At or below 30°.	Between 30° and 40°.	Above 40°.	Lowest Reading at Night.	Highest Reading at Night.
			in.	in.	grs.	grs.	in.	in.	Miles.				°	°
July -	78	+ 2	29·688	−0·109	538	0	1·99	−0·57	273	0	3	28	37·2	53·1
Aug. -	76	− 1	29·841	+0·060	529	+ 1	0·72	−1·71	253	0	7	24	32·5	56·0
Sept. -	86	+ 5	29·648	−0·154	551	− 2	3·82	+1·41	266	0	8	22	31·3	56·9
Means -	80	+2	29·726	−0·029	539	0	Sum 6·53	Sum −0·12	Mean 264	Sum 0	Sum 18	Sum 74	Lowest 32·5	Highest 56·9

Note.—In reading this table it will be borne in mind that the plus sign (+) signifies *above* the average, and that the minus sign (−) signifies *below* the average.

Average duration of the different directions of the wind referred to eight points of the compass, and duration of each direction in each month in the quarter, were as follows:—

Direction of Wind.	July. 1883.	July. Average.	July. Departure from Average.	August. 1883.	August. Average.	August. Departure from Average.	September. 1883.	September. Average.	September. Departure from Average.
	d.	d.	d.	d.	d.	d.	d.	d.	d.
N.W.	5½	2½	+ 2½	4	2½	+1½	5	2	+3
N.	1½	3½	− 2½	0	3½	−3½	1	4½	−3½
N.E.	½	3½	− 3	0	3½	−3½	1	5½	−4½
E.	0	1½	− 1½	2½	1½	+ 1	5	2½	+2½
S.E.	1	1	0	1½	1½	+ ½	2	2	0
S.	3½	3	+ ½	1½	3½	−1½	2	3	−1
S.W.	8½	11	− 2½	8½	10½	−2½	5	8	−3
W.	10½	4½	+ 6	13	4½	+8½	9	3	+6

The plus sign (+) denotes excesses over averages; the largest numbers affected with this sign in the month of July are opposite to W. and N.W.; in August to W. and N.W.; and in September to W. and N.W.

The minus sign (−) denotes deficiencies below averages. In July the largest numbers are opposite to N.E. and N.; in August to N. and N.E.; and in September to N.E. and N.

The mean reading of the barometer for the month of July at the height of 160 feet above the level of the sea was 29·688 ins., being 0·109 in. below the average of 42 years; 0·012 in. lower than that in 1882; and 0·137 in. lower than that in 1881.

The mean reading of the barometer for the month of August was 29·841 ins., being 0·060 in. above the average of 42 years, 0·101 in. above that in 1882, and 0·165 in. above that in 1881.

The mean reading of the barometer for the month of September was 29·648 ins., being 0·154 in. below the average of 42 years, 0·039 in. below that in 1882, and 0·153 in. below that in 1881.

(From the preceding 42 years' observations the mean pressure of July is 0·008 in. lower than in June; that in August is 0·016 in. lower than in July, and that in September is 0·021 in. higher than in August.)

From June to July there was a decrease of pressure at stations south of 51° of 0·081 in.; between 51° and 52° of 0·105 in.; between 52° and 53° of 0·134 in.; between 53° and 54° of 0·149 in. and north of 54° of 0·170 in.

From July to August there was an increase of pressure at stations south of 51° of 0·160 in.; between 51° and 52° of 0·159 in., between 52° and 53° of 0·165 in., between 53° and 54° of 0·165 in., and north of 54° of 0·119 in.

From August to September there was a decrease at stations south of 51° of 0·212 in., between 51° and 52° of 0·198 in., between 52° and 53° of 0·183 in., between 53° and 54° of 0·162 in., and north of 54° of 0·140 in.

Thunderstorms occurred in July on the 2nd at Guernsey, Osborne, Strathfield Turgiss, and Halifax; on the 3rd at Osborne, Marlborough, Cardington, Leicester and Halifax; on the 4th at Lowestoft, Wolverhampton, and Carlisle; on the 5th at Carlisle; on the 13th and 14th at Cardington; on the 14th at Truro, Osborne, Lowestoft, and Somerleyton; on the 15th at Osborne, Bath, and Cambridge; on the 21st at Cardington and Cambridge; on the 23rd at Bath; on the 31st at Strathfield Turgiss, Cardington, Lowestoft, and Somerleyton.

In August on the 8th at Barnet; and on the 9th at Silloth.

In September on the 20th at Torquay; and on the 21st at Ventnor.

Thunder was heard but lightning was not seen in July, on the 2nd at Wolverhampton; on the 3rd at Whitchurch, Cambridge, and Wolverhampton; on the 4th at Whitchurch; on the 11th at Cambridge; on the 13th at Truro, Bath, Marlborough, and Somerleyton; on the 14th at Strathfield Turgiss, Bath, Marlborough, Cambridge, and Wolverhampton; on the 15th at Marlborough and Wolverhampton; on the 21st at Osborne, Marlborough, and Somerleyton; on the 23rd and 24th at Carlisle; on the 25th at Cambridge; on the 26th at Whitchurch; and on the 31st at Marlborough.

In August, on the 3rd at Royston; on the 8th at Whitchurch and Halifax; on the 12th and 14th at Stonyhurst; and on the 22nd at Lowestoft.

In September on the 2nd at Whitchurch; on the 3rd at Silloth; on the 15th at Burslem, Bolton, and Stonyhurst; on the 18th at Stonyhurst and Silloth; on the 22nd at Torquay and Hull; on the 28th at Silloth.

Lightning was seen but thunder was not heard in July on the 2nd at Bath and Cambridge; on the 3rd at Bath, Whitchurch, Cambridge, and Lowestoft; on the 14th and 25th at Cambridge.

In August, on the 6th at Torquay, Osborne, and Oxford; and on the 26th at Stonyhurst and Carlisle.

In September, on the 18th at Stonyhurst; and on the 20th at Whitchurch, Cardington, Rugby, and Wolverhampton.

Solar halos were seen in July on the 1st at Halifax; on the 8th at Lowestoft; on the 19th at Strathfield Turgiss; on the 20th at Halifax; and on the 21st at Lowestoft.

In August, on the 5th at Stonyhurst; on the 12th at Halifax; on the 16th at Torquay and Stonyhurst; on the 19th at Torquay, Oxford, Burslem, and Halifax; on the 20th at Stonyhurst; on the 25th at Halifax; on the 26th and 27th at Torquay and Halifax.

In September, on the 4th at Stonyhurst; and on the 5th 7th, 17th, 23rd, and 25th at Torquay.

Lunar halos were seen in July, on the 18th at Bolton; and on the 19th at Lowestoft and Halifax.

In August, on the 11th at Ventnor; on the 16th at Ventnor and Halifax; on the 18th at Totnes, Torquay, and Halifax; on the 19th at Torquay and Oxford; and on the 21st at Halifax.

In September, on the 16th at Stonyhurst; and on the 19th at Cambridge.

Aurora borealis was seen in August, on the 6th at Whitchurch.

In September, on the 5th at Silloth.

Snow fell in July, on the 15th at Whitchurch.

Hail fell in July on the 3rd at Whitchurch; on the 4th at Wolverhampton; on the 14th at Truro and Somerleyton; on the 15th at Marlborough, Cambridge, and Stonyhurst; on the 21st at Truro and Whitchurch; on the 23rd at Bath.

In August, on the 3rd at Halifax; and on the 10th at Osborne.

In September, on the 16th and 17th at Stonyhurst; and on the 29th at Blackheath.

Fog prevailed in July, on the 19th at Stonyhurst; on the 24th and 27th at Bath; and on the 31st at Stonyhurst.

In August, on the 3rd at Stonyhurst; on the 4th at Strathfield Turgiss, Whitchurch, Barnet, Cardington, and Stonyhurst; on the 5th at Stonyhurst; on the 16th and 17th at Guernsey; on 19th at Barnet and Royston; on the 20th at Totnes and Torquay; on the 22nd and 24th at Bath; on the 25th at Bath, Barnet, Oxford, and Royston; on the 26th at Truro and Bath; on 27th at Guernsey; and on the 31st at Torquay.

In September, on the 1st at Cambridge; on the 4th at Torquay; on the 8th and 9th at Bolton; on the 10th at Guernsey; on the 13th at Blackheath, Cambridge, and Bolton; on the 14th at Cambrige; on the 15th at Bolton; on the 16th at Guernsey, Ventnor, Whitchurch, Blackheath, Cardington, Cambridge, and Bolton; on the 17th at Plymouth, Torquay, Ventnor, Whitchurch, Blackheath, Cambridge, Wolverhampton, Llandudno, and Hull; on the 18th at Whitchurch, Blackheath, Cambridge, Wolverhampton, Bolton, and Hull; on the 19th at Torquay, Blackheath, Cambridge, and Wolverhampton; on the 21st at Cambridge and Wolverhampton; on the 23rd at Whitchurch, Cardington, and Wolverhampton.

MONTHLY METEOROLOGICAL TABLE FOR THE QUARTER ENDING SEPTEMBER 30TH, 1883.

The Observations have been reduced to Mean values by Glaisher's Barometrical and Diurnal Range Tables, and the Hygrometrical results have been deduced from the sixth edition of his Hygrometrical Tables.

Names of Stations and Observers.	Height of Station above Sea Level.	Year 1883. Months.	Pressure of Atmosphere in Month. Mean.	Pressure of Atmosphere in Month. Range.	Temperature of Air in Month. Highest.	Temperature of Air in Month. Lowest.	Temperature of Air in Month. Range.	Temperature of Air in Month. Mean of all Highest.	Temperature of Air in Month. Mean of all Lowest.	Temperature of Air in Month. Mean Daily Range.	Mean Temperature. Air.	Mean Temperature. Dew Point.	Vapour. Elastic Force.	Vapour. In a cubic foot of Air. Mean.	Vapour. In a cubic foot of Air. Short of Saturation.	Mean Degree of Humidity. Sat. = 100.	Mean Weight of a cubic foot of Air.	Mean Reading of Thermometer. Maximum in Rays of Sun.	Mean Reading of Thermometer. Minimum on Grass.	Wind. Estimated Strength.	Wind. Relative Proportion of N.	Wind. Relative Proportion of E.	Wind. Relative Proportion of S.	Wind. Relative Proportion of W.	Mean Amount of Ozone.	Mean Amount of Cloud.	Rain. Number of Days it fell.	Rain. Amount collected.
	feet.		in.	in.	°	°	°	°	°	°	°	°	in.	grs.	gr.		grs.	°	°									
GUERNSEY, Adolphus Collenette, Esq., F.M.S.	270	July	29·641	0·872	74·9	47·5	27·4	64·9	53·2	11·7	58·0	54·6	·429	4·8	0·6	88	529	117·7	49·6	0·9	3	0	12	16	3·4	6·3	22	2·53
		Aug.	29·790	0·594	76·3	47·0	29·3	67·1	54·9	12·2	59·9	54·5	·448	4·7	1·1	83	530	117·5	51·5	0·9	5	1	8	22	3·3	5·4	15	2·08
		Sept.	29·582	1·374	69·0	48·0	21·0	63·1	53·8	9·3	57·5	54·6	·428	4·7	0·5	90	529	106·3	48·8	1·2	6	6	5	13	3·4	6·9	21	5·73
TRURO (Cornwall), C. Barham, Esq., M.D., F.M.S.	43	July	29·800	0·800	71·0	48·0	23·0	66·5	53·2	13·3	56·9	52·7	·398	4·6	0·8	86	533	—	—	2·4	7	1	10	13	—	7·3	18	2·78
		Aug.	29·959	0·623	77·0	49·0	27·0	69·7	52·8	16·9	58·6	53·1	·406	4·7	0·8	81	535	—	—	3·1	5	2	9	15	—	6·7	11	1·11
		Sept.	29·754	1·698	71·0	39·0	32·0	64·6	52·0	12·6	56·3	53·0	·404	4·5	0·5	87	533	—	—	2·4	4	4	11	11	—	6·6	18	5·73
PLYMOUTH (Devon), J. Merrifield, Esq., LL.D., F.R.A.S., F.M.S.	69	July	29·803	0·641	72·0	47·0	25·0	65·8	53·9	11·9	59·6	54·5	·426	4·7	0·9	84	530	—	—	1·6	6	2	9	14	—	7·9	23	2·64
		Aug.	29·969	0·636	71·1	45·0	26·1	66·6	54·3	12·4	59·9	54·2	·429	4·8	1·0	84	533	—	—	1·1	7	3	8	13	—	6·8	12	1·01
		Sept.	29·781	1·667	68·9	42·5	26·4	63·1	51·3	11·8	56·5	53·0	·401	4·5	0·6	88	533	—	—	1·4	6	4	6	14	—	7·4	18	5·10
TOTNES (Devon), T. H. Edmonds, Esq.	107	July	29·795	0·685	73·3	43·8	29·5	66·9	51·5	15·4	58·0	52·1	·391	4·4	1·0	81	532	—	—	2·7	6	2	9	15	—	7·1	24	2·92
		Aug.	29·955	0·639	77·7	40·1	37·6	69·4	51·3	18·1	59·6	53·2	·406	4·6	1·1	80	533	—	—	2·5	5	2	5	19	—	5·8	15	1·38
		Sept.	29·757	1·652	72·0	36·1	35·9	64·4	49·6	14·8	56·2	51·1	·376	4·3	0·8	84	534	—	—	2·9	8	3	4	15	—	6·4	21	6·08
TORQUAY, Babbacombe (Devon), Edwin E. Glyde, Esq., F.M.S.	305	July	29·874	0·710	73·4	46·0	28·4	65·0	51·5	13·5	56·9	51·3	·378	4·2	1·0	92	539	124·7	43·5	1·4	5	2	7	17	4·4	6·9	23	4·80
		Aug.	29·723	0·657	75·9	47·1	28·8	67·8	53·1	14·7	59·4	53·4	·395	4·6	1·1	78	530	123·4	45·2	1·2	4	4	9	19	4·4	6·5	15	0·75
		Sept.	29·526	1·644	67·4	44·7	22·7	63·8	50·9	11·9	56·0	51·0	·375	4·2	0·5	89	539	112·2	43·4	1·4	8	5	6	11	5·8	6·6	19	4·81
VENTNOR, (Isle of Wight) (Royal National Hospital for Consumption), Hartley Sagar, Esq.	80	July	29·794	0·804	70·9	47·1	23·8	65·6	54·0	11·6	58·0	52·7	·397	4·5	0·9	83	532	—	—	—	3	1	8	19	—	6·7	21	2·01
		Aug.	29·964	0·754	77·1	51·9	25·2	69·6	56·9	12·7	61·5	54·8	·429	4·8	1·3	79	531	—	—	—	4	6	8	13	—	5·4	11	0·72
		Sept.	29·728	1·415	70·4	47·8	22·6	64·7	54·2	10·5	59·4	52·6	·400	4·4	1·3	79	530	—	—	—	7	3	4	11	—	6·6	15	4·34
EASTBOURNE, (Sussex), Miss W. L. Hall.	13	April	29·945	1·196	65·4	30·6	34·8	56·6	38·7	17·9	46·1	39·5	·248	2·8	0·8	78	549	105·1	32·3	0·2	7	10	8	5	—	—	5	1·70
		May	30·062	0·822	72·2	32·2	40·0	62·4	41·7	17·7	52·4	43·1	·279	3·1	1·1	71	551	113·4	41·7	0·8	5	6	11	9	—	—	11	2·47
		June	29·907	0·356	77·2	41·7	35·5	68·8	50·6	18·2	58·6	50·0	·375	4·3	1·3	76	534	120·7	48·1	0·3	4	3	11	12	—	—	9	1·00
		July	29·813	0·596	73·5	46·4	26·1	67·9	53·2	14·7	59·4	52·1	·387	4·4	0·9	77	531	122·8	50·7	0·3	3	0	11	17	—	—	15	2·40
		Aug.	30·003	0·646	80·4	46·5	33·9	71·4	54·6	16·4	61·9	53·8	·414	4·6	1·6	74	532	121·9	51·8	0·2	2	3	9	17	—	—	14	0·61
		Sept.	29·749	1·374	72·2	40·9	31·3	66·2	51·8	14·4	58·1	53·5	·412	4·6	0·8	84	531	112·8	48·2	0·6	7	4	7	12	—	—	19	4·65
SOUTHBOURNE, (near) Bournemouth (Hants), T. A. Compton, Esq., M.D., B.A., F.M.S.	95	July	29·720	1·512	68·5	41·0	27·5	63·2	51·2	12·0	56·5	51·0	·376	4·4	0·7	82	533	—	—	2·0	9	4	7	10	—	5·9	19	5·37
		Aug.	29·940	0·630	77·2	46·3	30·9	68·3	54·1	14·2	60·4	54·1	·418	4·7	1·3	80	532	—	—	1·0	8	4	6	13	—	5·0	11	0·42
		Sept.	29·769	0·574	73·0	47·3	24·7	64·4	53·9	11·4	57·9	52·8	·392	4·4	1·0	81	532	—	—	1·1	4	1	12	14	—	5·8	17	3·11
OSBORNE (Isle of Wight), J. R. Mann, Esq.	172	July	29·698	0·696	79·1	45·2	33·9	69·5	53·5	17·0	59·1	54·3	·415	4·8	0·9	85	539	121·5	51·0	0·1	2	1	13	15	—	6·1	18	2·31
		Aug.	29·864	0·632	83·0	48·4	34·6	72·6	54·6	18·0	61·7	55·9	·449	5·0	1·5	76	539	119·1	52·7	0·3	2	3	11	15	—	5·3	13	1·24
		Sept.	29·658	1·434	73·9	42·2	30·7	65·2	51·2	14·0	56·9	52·6	·427	4·9	0·5	93	531	109·8	49·6	0·8	7	6	9	8	—	6·4	17	3·73
BRIGHTON, F. E. Sawyer, Esq., F.M.S.	206	July	29·666	0·650	75·3	42·6	32·7	69·8	53·0	16·8	59·8	51·7	·385	4·3	1·5	75	528	115·1	47·4	1·0	5	1	11	14	—	8·3	15	1·93
		Aug.	29·838	0·652	77·0	50·0	27·0	70·7	55·4	15·3	61·6	53·4	·409	4·5	1·6	75	529	113·9	47·0	0·8	3	2	17	8	—	5·8	13	0·83
		Sept.	29·613	1·344	70·0	44·0	26·0	65·0	52·1	12·9	57·4	54·2	·421	4·7	0·6	89	529	98·7	46·0	1·3	6	5	10	9	—	5·8	17	3·74
SALISBURY (Wilton House), Wilts, Thomas Challis, Esq.	186	July	29·669	0·650	80·0	37·0	43·0	70·2	48·7	21·5	58·1	53·3	·400	4·6	0·8	84	530	113·5	48·1	1·3	7	1	11	12	—	7·2	24	4·71
		Aug.	29·830	0·654	82·0	38·5	43·5	74·0	48·8	25·2	60·6	53·7	·413	4·6	1·7	78	530	116·3	47·9	1·4	11	2	7	11	—	5·7	16	0·91
		Sept.	29·627	1·524	77·0	34·0	43·0	66·8	46·8	20·0	55·9	50·9	·378	4·3	0·7	84	531	104·8	46·6	1·2	6	2	14	8	—	6·5	25	3·69

Names of Stations and Observers.	Height of Station above Sea Level.	Year 1883. Months.	Pressure of Atmosphere in Month. Mean.	Pressure of Atmosphere in Month. Range.	Temperature of Air in Month. Highest.	Temperature of Air in Month. Lowest.	Temperature of Air in Month. Range.	Temperature of Air in Month. Mean of all Highest.	Temperature of Air in Month. Mean of all Lowest.	Temperature of Air in Month. Mean Daily Range.	Mean Temperature. Air.	Mean Temperature. Dew Point.	Vapour. Elastic Force.	Vapour. In a Cubic foot of Air. Mean.	Vapour. In a Cubic foot of Air. Amt. of Saturation.	Mean Degree of Humidity. Sat. = 100.	Mean Weight of a cubic foot of Air.	Mean Reading of Thermometer. Maximum in Rays of Sun.	Mean Reading of Thermometer. Minimum on Grass.	Wind. Estimated Strength.	Wind. Relative Proportion of N.	Wind. Relative Proportion of E.	Wind. Relative Proportion of S.	Wind. Relative Proportion of W.	Mean Amount of Ozone.	Mean Amount of Cloud.	Rain. Number of Days it fell.	Rain. Amount collected.
	feet.		in.	in.	°	°	°	°	°	°	°	°	in.	grs.	gr.		grs.	°	°								in.
BARNSTAPLE (Devon), William Knill, Esq.	43	July	29·836	0·740	76·0	47·0	29·0	69·3	55·6	13·7	60·3	55·0	·457	4·8	1·1	83	530	—	—	1·4	4	1	14	12	—	3·8	22	4·74
		Aug.	30·010	0·660	78·0	48·0	30·0	70·0	57·9	12·1	61·2	54·3	·423	4·7	1·3	79	543	—	—	1·3	0	0	10	21	—	3·3	16	2·29
		Sept.	29·773	1·380	74·0	36·5	37·5	66·0	52·6	13·4	58·5	54·8	·423	4·8	0·7	88	531	—	—	1·5	8	5	9	8	—	3·8	17	5·19
STRATHFIELD TURGISS (Hants), Rev. C. H. Griffith, M.A., F.M.S.	197	July	29·668	0·664	81·5	41·9	39·6	68·7	50·2	18·5	58·0	51·5	·381	4·3	1·1	79	530	151·7	45·0	1·0	3	1	10	17	2·7	7·3	19	2·88
		Aug.	29·823	0·656	80·8	42·0	38·8	72·7	49·8	22·9	60·3	52·4	·394	4·4	1·1	78	530	118·1	43·7	0·8	3	3	8	17	2·4	7·0	12	0·67
		Sept.	29·632	1·506	72·8	36·4	36·4	65·9	46·6	17·1	56·0	52·1	·391	4·4	0·6	87	531	109·5	42·2	1·1	7	4	9	10	1·8	5·9	14	3·13
BATH (Somerset), St. Gregory's College, Downside, Rev. T. J. Almond, O.S.B., F.M.S.	596	July	29·225	0·683	74·4	43·0	28·4	63·4	50·8	12·6	55·8	51·5	·384	4·3	0·8	87	525	125·5	—	1·2	3	1	12	15	—	7·1	19	5·13
		Aug.	29·375	0·659	75·0	46·4	28·6	65·7	51·9	13·8	57·8	53·4	·396	4·4	0·9	88	525	121·7	—	1·3	4	2	6	19	—	6·0	17	3·15
		Sept.	29·182	1·656	72·2	42·3	29·9	61·7	49·8	11·9	54·4	50·2	·367	4·2	0·6	87	525	108·4	—	1·8	7	4	7	12	—	6·0	21	7·03
MARLBOROUGH (Wilts), Rev. Thomas A. Preston, M.A., F.M.S.	456	July	29·365	0·681	76·4	39·8	36·6	65·8	49·8	16·0	56·6	50·7	·370	4·2	0·9	80	526	123·4	46·5	0·9	8	1	12	10	—	7·8	18	3·67
		Aug.	29·515	0·690	75·7	43·3	32·4	69·1	51·2	17·9	59·2	53·1	·405	4·5	1·1	83	526	119·0	47·4	0·4	5	3	7	16	—	5·5	12	0·97
		Sept.	29·321	1·516	73·0	36·6	36·4	63·3	48·6	14·7	54·6	50·1	·360	4·0	0·6	83	527	108·9	44·7	0·7	5	9	6	10	—	7·1	20	4·20
WHITCHURCH RECTORY (Oxon), (near Reading), Rev. J. Slatter, M.A., F.M.S.	150	July	29·710	0·600	81·2	40·0	41·2	70·0	48·2	21·8	59·2	52·8	·396	4·4	1·1	79	530	—	—	1·5	3	1	10	17	—	7·5	16	2·42
		Aug.	29·877	0·688	79·0	43·6	35·4	72·4	49·4	23·0	60·0	52·8	·392	4·4	1·4	76	532	—	—	1·3	4	4	9	14	—	5·4	10	0·96
		Sept.	29·685	1·484	72·8	37·6	35·2	64·1	44·4	19·7	54·3	50·5	·367	4·1	0·7	85	534	—	—	1·4	8	4	7	11	—	7·1	19	3·24
BLACKHEATH (Kent), James Glaisher, Esq., F.R.S.	150	July	29·695	0·626	85·0	44·5	40·5	69·0	53·8	16·2	58·9	51·3	·378	4·3	1·3	76	530	121·2	45·5	0·8	4	1	8	18	—	6·5	15	1·91
		Aug.	29·841	0·709	84·0	47·4	36·6	73·0	54·4	17·6	62·2	50·2	·365	4·1	2·2	63	529	115·3	47·7	1·2	2	3	6	20	—	5·2	12	0·54
		Sept.	29·663	1·460	75·2	43·5	21·7	65·1	50·8	14·3	56·9	51·7	·384	4·3	0·9	83	531	107·2	43·4	1·1	4	6	6	14	—	6·1	16	4·61
ROYAL OBSERVATORY, Greenwich, W. H. M. Christie, M.A., F.R.S., Astronomer Royal.	159	July	29·688	0·654	83·3	43·6	39·7	70·7	51·3	19·4	59·8	53·1	·404	4·5	1·3	74	528	129·0	44·9	—	—	—	—	—	—	6·7	7·5	16	2·00
		Aug.	29·840	0·682	85·1	44·8	40·3	74·0	52·8	21·2	62·0	54·1	·419	4·6	1·6	76	529	127·9	44·6	—	—	—	—	—	—	3·4	6·3	10	0·71
		Sept.	29·648	1·411	77·1	41·5	35·6	66·4	49·7	16·7	56·8	53·4	·394	4·4	0·8	86	531	112·7	41·9	—	—	—	—	—	—	2·8	6·1	17	3·82
CAMDEN SQUARE (London), G. J. Symons, Esq., F.R.S., F.M.S.	123	July	29·727	0·668	84·7	42·1	42·6	70·5	52·1	18·4	59·9	50·7	·371	4·1	1·7	81	529	113·9	48·1	—	6	7	5	13	—	6·4	14	2·92
		Aug.	29·880	0·713	82·7	46·9	35·8	73·4	54·2	19·2	62·4	52·8	·400	4·5	1·6	71	529	118·2	49·6	—	—	—	—	—	—	5·7	10	0·98
		Sept.	29·690	1·377	75·3	41·4	33·9	66·7	50·2	16·5	57·0	53·0	·402	4·5	0·7	84	531	100·4	45·8	—	10	4	7	9	—	6·0	18	3·83
BARNET (Gas Works), T. H. Martin, Esq., C.E.	212	July	29·661	0·638	82·5	40·6	41·9	70·1	49·6	20·5	58·3	50·7	·371	4·2	1·3	76	530	—	40·8	0·8	8	3	5	15	—	6·9	13	2·47
		Aug.	29·823	0·701	81·5	39·0	42·5	72·2	50·3	21·9	60·3	51·1	·376	4·2	1·7	72	530	125·6	41·4	0·6	7	5	8	16	—	5·8	7	0·73
		Sept.	29·627	1·453	74·0	34·3	39·7	66·3	46·1	20·2	55·4	51·5	·382	4·3	0·7	87	532	108·5	37·8	0·9	6	7	6	11	—	6·0	18	4·26
OXFORD (The Observatory), E. J. Stone, Esq., M.A., F.R.S.	210	July	29·628	0·707	78·3	42·7	35·6	66·2	52·2	14·0	58·7	53·6	·397	4·4	1·2	80	532	117·8	47·3	2·4	5	2	11	13	2·6	7·3	21	3·46
		Aug.	29·792	0·736	78·4	45·6	30·8	69·8	53·2	16·6	61·1	53·9	·417	4·7	1·4	78	529	119·1	47·3	2·4	3	2	9	17	2·6	5·8	12	0·54
		Sept.	29·595	1·553	74·0	40·7	33·3	64·0	50·9	13·1	56·5	51·9	·387	4·3	0·8	85	530	106·2	45·9	2·9	6	4	10	10	1·8	6·9	18	4·07
ROYSTON (Hertfordshire), Hale Wortham, Esq., F.R.A.S., F.M.S.	269	July	29·585	0·690	80·7	43·6	37·1	70·1	50·6	19·5	57·6	53·5	·410	4·7	1·0	85	529	—	—	—	5	1	10	14	—	7·2	15	2·70
		Aug.	29·744	0·764	81·4	46·0	35·4	72·1	52·2	19·9	60·3	54·8	·450	4·8	1·1	81	529	—	—	—	4	4	7	16	—	6·2	13	1·00
		Sept.	29·555	1·453	74·3	42·1	32·2	65·6	49·3	16·3	55·7	51·5	·373	4·2	0·7	80	530	—	—	—	7	5	7	11	—	5·5	16	4·25
BEDFORD, Cardington, Mr. J. McLaren, Assistant to S. Whitbread, Esq., M.P.	105	July	29·750	0·656	83·6	41·2	42·4	70·3	50·0	20·3	58·9	53·3	·396	4·3	1·3	78	531	107·7	48·3	1·5	7	1	7	16	—	7·0	17	3·29
		Aug.	29·910	0·746	82·2	42·0	40·2	72·6	50·6	22·0	60·4	53·4	·395	4·4	1·3	75	532	95·1	47·8	1·9	6	2	6	17	—	5·6	8	0·95
		Sept.	29·712	1·530	77·8	38·6	39·2	65·7	48·8	16·9	56·1	51·6	·385	4·3	0·7	85	533	88·0	46·9	2·0	8	4	7	11	—	6·3	15	4·55
CAMBRIDGE (Trinity College), J. W. L. Glaisher, Esq., M.A., F.R.S.	40	July	29·780	0·670	81·1	41·0	40·1	71·3	50·4	20·9	58·6	53·9	·402	4·5	0·8	82	531	141·2	46·3	1·2	4	1	3	23	—	7·1	17	2·52
		Aug.	29·929	0·760	83·2	41·5	41·7	73·5	50·9	22·6	60·8	51·5	·381	4·2	1·7	71	533	132·2	45·2	1·0	3	3	9	16	—	5·8	7	0·89
		Sept.	29·760	1·626	76·8	39·7	37·1	67·0	49·0	18·0	56·6	52·4	·394	4·4	0·7	85	533	115·1	42·8	1·4	5	4	7	14	—	6·1	16	4·35
RUGBY (Warwickshire), Stockton, The Rectory, Rev. W. Tuckwell.	289	July	29·422	0·680	80·0	40·0	40·0	67·7	48·6	19·1	57·2	52·6	·394	4·3	1·0	88	526	—	—	0·6	2	3	11	15	—	7·0	19	3·67
		Aug.	29·561	0·724	78·0	40·3	37·7	70·7	49·3	21·4	58·6	50·9	·372	4·2	1·3	76	529	—	—	0·6	6	2	7	16	—	6·4	11	0·66
		Sept.	29·401	1·532	76·6	35·5	41·1	68·0	47·4	20·6	55·4	51·5	·382	4·3	0·7	87	528	—	—	0·6	5	4	12	9	—	6·5	18	3·84

Names of Stations and Observers.	Height of Station above Sea Level.	Year 1883.	Pressure of Atmosphere in Month.		Temperature of Air in Month.						Mean Temperature.		Vapour.			Mean Degree of Humidity. Sat.ⁿ = 100.	Mean Weight of a cubic foot of Air.	Mean Reading of Thermometer.		Wind.					Mean Amount of Ozone.	Mean Amount of Cloud.	Rain.	
								Mean						In a cubic foot of Air.						Estimated Strength.	Relative Proportion of						Number of Days it fell.	Amount collected.
		Months.	Mean.	Range.	Highest.	Lowest.	Range.	Of all Highest.	Of all Lowest.	Daily Range.	Air.	Dew Point.	Elastic Force.	Mean.	Short of Saturation.			Maximum in Rays of Sun.	Minimum on Grass.		N.	E.	S.	W.				
	feet.		in.	in.	°	°	°	°	°	°	°	°	in.	grs.	gr.		grs.	°	°									in.
LOWESTOFT (Suffolk), S. H. Miller, Esq., F.R.A.S., F.M.S.	89	July	29·718	0·632	74·0	42·3	31·7	65·8	52·8	13·0	57·9	50·1	·363	4·0	1·6	70	539	119·4	48·7	0·7	5	1	6	19	·	·	6·9	19	3·82
		Aug.	29·868	0·792	77·0	42·5	34·5	68·0	52·2	15·8	59·7	52·8	·394	4·4	1·4	77	533	116·5	48·7	0·5	4	6	7	14	·	·	6·3	22	1·03
		Sept.	29·695	1·374	71·6	40·0	31·6	64·3	50·2	14·1	56·6	51·4	·378	4·0	1·1	82	532	107·9	44·8	0·6	6	5	6	18	·	·	5·6	19	1·70
SOMERLEYTON (Suffolk), The Rectory, Rev. C. J. Steward, F.M.S.	50	July	29·768	0·634	77·8	39·0	38·8	66·8	51·3	15·5	57·4	51·4	·371	4·0	1·0	80	532	—	—	1·0	4	2	10	15	4·6	5·8	15	2·97
		Aug.	29·932	0·896	77·5	41·8	35·7	68·6	51·9	16·7	59·0	52·4	·394	4·5	1·1	79	534	—	—	1·0	4	4	9	14	4·1	5·5	9	1·10
		Sept.	29·749	1·236	74·0	40·0	34·0	64·6	49·9	14·7	56·3	52·0	·390	4·4	0·8	84	530	—	—	1·1	4	6	10	10	4·5	5·0	14	1·88
WOLVERHAMPTON (Staffordshire), Wrottesley, E. Simpson, Esq.	800	July	29·332	0·738	76·7	40·5	36·2	65·2	48·5	16·7	55·5	49·0	·349	4·0	1·0	79	527	—	—	—	6	2	12	11	·	8·1	20	3·02
		Aug.	29·494	0·767	75·5	42·5	33·0	64·1	49·6	18·5	57·5	49·7	·356	3·9	1·5	78	532	—	—	—	5	1	11	14	·	6·9	9	1·18
		Sept.	29·283	1·608	70·5	37·8	32·7	61·8	47·5	14·3	53·6	49·5	·353	4·0	0·6	86	528	—	—	—	5	6	10	9	·	7·4	18	4·53
LEICESTER (Town Museum), J. C. Smith, Esq.	338	July	29·558	0·772	80·0	40·0	40·0	67·4	51·2	16·2	58·0	50·8	·373	4·2	1·2	77	538	118·5	39·2	0·6	7	3	6	15	·	7·6	22	4·74
		Aug.	29·705	0·832	79·3	44·0	35·3	69·9	51·2	18·7	59·8	51·2	·376	4·2	1·5	73	529	118·8	42·2	0·5	4	4	9	14	·	5·4	12	0·99
		Sept.	29·530	1·536	72·2	40·8	31·4	64·7	49·9	14·8	55·9	51·1	·374	4·3	0·7	86	530	103·7	41·5	0·7	8	4	9	9	·	6·7	21	5·31
NOTTINGHAM (Notts), M.O. Tarbotton, Esq., C.E., F.G.S., F.M.S.	183	July	29·609	0·690	84·2	39·8	44·4	70·7	49·7	21·0	58·4	51·8	·385	4·3	1·2	78	529	111·6	47·3	0·2	7	5	9	10	1·6	6·6	16	2·79
		Aug.	29·766	0·862	78·1	41·2	36·9	70·9	49·8	21·1	59·1	51·9	·387	4·4	1·2	77	531	110·7	48·3	0·3	2	3	8	18	1·0	6·4	17	1·37
		Sept.	29·575	1·514	73·8	38·6	35·2	64·6	48·9	15·7	55·5	50·8	·373	4·2	0·8	85	531	80·0	47·7	0·3	6	7	7	10	0·9	5·9	22	4·63
BURSLEM, J. E. Worth, Esq., C.E., F.M.S.	556	July	29·219	0·753	75·4	42·7	32·7	65·2	49·7	15·5	55·7	50·5	·368	4·1	0·8	83	524	—	—	0·9	6	2	9	14	·	8·3	21	2·80
		Aug.	29·376	0·845	73·5	44·8	28·7	67·1	50·6	16·5	57·4	50·5	·363	4·1	1·2	78	526	—	—	1·1	5	1	8	17	·	6·3	18	2·05
		Sept.	29·182	1·567	70·3	40·3	30·0	63·0	48·5	14·5	54·1	49·7	·356	4·1	0·6	85	526	—	—	1·2	5	6	9	10	·	7·1	25	5·87
HOLKHAM (Norfolk), John Davidson, Esq., Assistant to the Earl of Leicester.	39	April	29·952	1·244	67·3	22·2	45·1	53·6	34·5	19·3	43·9	39·9	·247	2·8	0·4	86	551	100·6	32·2	1·0	14	8	6	2	·	6·1	9	1·87
		May	29·852	0·902	74·7	38·8	45·9	58·9	40·4	18·5	49·0	45·7	·307	3·5	0·5	89	544	122·7	37·0	1·2	13	4	10	4	·	5·1	10	1·50
		June	29·909	0·736	78·7	34·9	43·8	63·9	45·6	18·3	54·0	48·8	·350	3·6	0·7	84	539	128·2	43·5	1·2	10	8	9	3	·	5·8	12	3·50
		July	29·751	0·633	80·3	35·0	45·3	66·8	48·4	18·4	57·0	52·0	·387	4·3	0·9	83	532	123·1	46·7	1·6	7	1	14	9	·	6·3	17	2·37
		Aug.	29·889	0·844	69·7	37·2	52·5	68·6	48·4	20·2	58·4	51·5	·383	4·3	1·0	78	534	124·4	45·1	1·2	9	2	15	5	·	5·4	8	1·19
		Sept.	29·755	1·120	69·9	38·0	31·9	63·1	45·9	17·2	54·8	50·5	·367	4·1	0·7	85	535	111·0	43·2	1·2	12	2	15	1	·	5·3	15	5·75
LLANDUDNO (Carnarvonshire), James Nicol, Esq., M.D.	100	July	29·712	0·810	67·8	47·8	20·0	62·9	53·1	9·8	56·9	50·5	·368	4·0	1·2	80	532	—	—	0·9	5	5	8	13	·	8·6	13	1·15
		Aug.	29·852	0·900	69·0	48·8	20·2	64·6	53·9	10·7	59·5	53·7	·411	4·6	0·9	83	534	—	—	0·9	5	3	4	19	·	6·7	13	1·82
		Sept.	29·679	1·670	62·6	46·0	22·6	61·0	52·2	8·8	56·2	50·2	·366	4·0	1·1	81	532	—	—	1·0	6	6	7	11	·	6·9	19	3·38
LIVERPOOL, The Observatory, John Hartnup, Esq., F.R.A.S.	197	July	29·750	0·908	73·5	49·5	24·0	64·9	54·1	10·8	57·9	52·5	·397	4·4	1·0	83	531	—	—	—	1	2	11	17	·	6·6	16	2·39
		Aug.	29·600	0·867	73·4	48·8	24·6	63·7	53·8	10·4	57·0	49·3	·351	3·9	1·3	75	530	—	—	—	3	2	8	18	·	7·0	18	2·98
		Sept.	29·564	1·647	70·0	46·5	23·5	61·6	51·6	10·0	55·3	50·2	·364	4·0	0·7	82	531	—	—	—	5	10	5	10	·	6·3	18	5·30
BOLTON, Sharples (Lancashire), Rev. T. Mackereth, F.R.A.S., F.M.S.	500	July	29·271	0·836	73·9	44·0	29·9	63·2	49·5	13·7	55·0	49·7	·357	4·0	0·9	83	537	78·6	43·6	1·4	6	2	10	13	3·6	8·0	24	3·76
		Aug.																										
		Sept.	29·348	1·588	72·3	41·6	30·7	61·1	48·6	12·3	53·8	49·5	·353	4·0	0·6	86	537	74·9	47·6	0·9	6	6	8	10	2·8	7·1	20	7·89
HALIFAX, Bermerside Observatory (Yorkshire), E. J. Crossley, Esq., F.R.A.S.	530	July	—	0·714	77·2	41·1	36·1	64·1	46·9	17·2	54·8	47·6	·325	3·7	1·1	75	—	107·5	41·5	—	4	4	9	14	·	—	13	3·11
		Aug.	29·496	0·927	78·5	43·2	35·3	68·0	49·3	18·7	57·0	49·3	·351	3·9	1·3	75	527	110·6	45·9	0·9	1	1	13	16	·	6·0	11	1·63
		Sept.	29·252	1·503	72·0	40·0	32·0	61·9	47·8	14·1	53·4	49·4	·353	3·9	0·6	87	527	94·5	47·7	0·8	6	7	9	8	·	6·6	19	6·69
HULL (Yorkshire), The People's Park, Mr. E. Peak.	12	July																										
		Aug.	29·927	0·960	77·0	42·0	35·0	69·9	49·7	20·2	59·3	51·8	·378	4·3	1·0	74	533	93·6	48·4	1·3	3	2	9	17	·	4·5	13	1·33
		Sept.	29·777	1·532	72·0	40·0	32·0	63·6	48·5	15·1	55·6	49·6	·357	4·0	0·9	81	535	78·4	47·5	1·3	7	5	9	9	·	6·3	19	3·89
STONYHURST (Lancashire), Rev. S. J. Perry, F.R.S., F.M.S., F.R.A.S.	363	July	29·419	0·887	79·0	40·9	38·1	67·7	48·2	19·5	56·0	50·2	·365	4·1	0·9	81	538	128·8	47·1	—	4	1	8	18	·	9·1	20	3·03
		Aug.	29·554	0·933	78·0	41·0	37·0	67·7	48·7	19·0	56·9	50·9	·373	4·1	1·1	81	539	123·0	48·7	—	0	0	4	27	·	8·3	17	3·46
		Sept.	29·391	1·564	72·0	37·7	34·3	63·3	45·2	15·1	54·5	48·9	·346	3·9	1·0	81	529	108·1	47·3	—	8	7	5	10	·	7·8	18	6·67

Names of Stations and Observers.	Height of Station above Sea Level.	Year 1883. Months.	Pressure of Atmosphere in Month. Mean.	Pressure of Atmosphere in Month. Range.	Temperature of Air in Month. Highest.	Lowest.	Range.	Mean of all Highest.	Mean of all Lowest.	Mean Daily Range.	Mean Temperature. Air.	Dew Point.	Vapour. Elastic Force.	Vapour. In a cubic foot of Air. Mean.	Vapour. In a cubic foot of Air. Short of Saturation.	Mean Degree of Humidity. Sat. = 100.	Mean Weight of a cubic foot of Air.	Mean Reading of Thermometer. Maximum in Rays of Sun.	Mean Reading of Thermometer. Minimum on Grass.	Wind. Estimated Strength.	Wind. Relative Proportion of N.	Wind. Relative Proportion of E.	Wind. Relative Proportion of S.	Wind. Relative Proportion of W.	Mean Amount of Ozone.	Mean Amount of Cloud.	Rain. Number of Days it fell.	Rain. Amount collected.
	feet.		in.	in.	°	°	°	°	°	°	°	°	in.	grs.	gr.		grs.	°	°								in.	
BRADFORD (Yorkshire), J. McLandsborough, Esq., C.E., F.G.S.	366	July	29·393	0·886	76·2	45·8	30·4	65·9	52·2	13·7	57·5	49·5	·354	3·9	1·4	74	526	88·1	—	1·0	3	3	8	17	—	6·2	20	3·86
		Aug.	29·514	0·972	74·2	49·0	25·2	67·4	53·2	14·2	58·4	51·9	·385	4·3	1·2	79	527	86·6	—	1·0	2	1	10	18	—	6·0	16	2·09
		Sept.	29·407	1·543	68·7	44·1	24·6	61·7	50·7	11·0	55·0	51·7	·383	4·3	0·6	89	528	76·1	—	1·2	8	8	5	9	—	7·3	22	6·23
LEEDS (Yorkshire), The Philosophical Hall, Henry Crowther, Esq.	137	July	29·634	0·838	77·0	46·0	31·0	67·9	51·7	16·2	58·3	52·2	·388	4·3	1·2	78	530	—	—	1·2	6	4	7	14	—	7·0	17	3·25
		Aug.	29·772	0·256	77·0	42·0	35·0	69·3	52·4	16·9	60·0	51·9	·397	4·3	1·5	75	530	—	—	1·3	2	1	6	22	—	5·6	10	1·78
		Sept.	29·639	1·510	74·0	45·0	29·0	63·6	51·3	11·3	56·2	51·7	·385	4·4	0·7	85	531	—	—	1·2	6	10	4	10	—	6·6	18	4·15
LANCASTER (Southfields), William Roper, Esq.	114	July	29·625	0·833	73·0	42·0	30·0	64·1	49·9	14·2	56·6	49·7	·357	4·2	0·6	77	531	—	—	—	—	—	—	—	—	—	19	2·19
		Aug.	29·806	0·880	73·0	42·0	31·0	64·7	58·7	6·0	59·2	51·8	·361	4·3	1·2	77	531	—	—	—	—	—	—	—	—	—	18	3·12
		Sept.	29·589	1·028	72·0	39·0	33·0	63·1	48·4	14·7	55·0	49·1	·342	3·9	1·0	81	532	—	—	—	—	—	—	—	—	—	18	4·90
SILLOTH (Cumberland), "The Rectory," Rev. F. Redford, M.A., F.R.A.S., F.M.S.	28	July	29·752	1·087	71·4	42·5	28·9	65·9	49·8	16·1	56·7	50·9	·371	4·2	1·1	81	533	128·0	47·1	1·0	2	4	6	19	7·8	5·7	18	2·81
		Aug.	29·969	1·020	70·1	48·2	26·9	65·2	50·8	14·4	57·0	51·2	·377	4·2	1·0	81	535	121·1	47·6	1·4	3	1	6	21	8·3	6·1	20	4·10
		Sept.	29·720	1·536	70·0	37·0	33·0	62·3	48·4	13·9	54·2	48·3	·337	3·9	0·9	80	535	109·8	45·0	1·5	6	11	4	9	8·6	5·9	18	3·54
CARLISLE, Spital (Cumberland), Isaac Cartmel, Esq., F.M.S.	114	July	29·645	0·962	75·8	41·4	34·4	67·4	48·7	18·7	56·3	52·0	·390	4·3	0·8	86	531	105·1	42·9	0·8	5	6	6	14	4·0	8·2	19	3·18
		Aug.	29·765	1·042	73·8	39·4	34·4	67·0	49·0	18·0	56·7	52·3	·392	4·4	1·1	85	533	101·2	42·4	0·9	5	6	6	14	4·3	8·8	15	2·68
		Sept.	29·634	1·480	72·8	34·8	38·0	64·1	47·5	16·6	54·4	48·7	·340	3·9	0·9	79	533	90·1	41·4	0·8	3	10	6	11	4·5	8·1	19	3·28

Second Rain-gauges are placed—

				April.		May.		June.		July.		August.		September.		Total in Quarter.	
At Eastbourne, at the height of	160	feet	*above the sea;* the amount collected was	1·73	inches.	2·37	inches.	1·14	inches.	2·55	inches.	0·77	inches.	3·06	inches.	8·33	inches.
,, Beachy Head, ,,	515	,,	,, ,,	1·17	,,	2·38	,,	1·44	,,	2·05	,,	0·26	,,	3·91	,,	6·22	,,
,, ,, ,, ,,	495	,,	,, ,,	1·45	,,	2·38	,,	1·45	,,	2·17	,,	0·39	,,	4·63	,,	7·19	,,
,, Oxford, ,,	22	,,	*ground* ,,	0·99	,,	1·85	,,	3·68	,,	3·43	,,	0·49	,,	3·94	,,	7·86	,,
,, Cardington, ,,	21	,,	,, ,,	1·84	,,	1·70	,,	2·64	,,	3·44	,,	0·90	,,	4·48	,,	8·82	,,
,, Nottingham, ,,	39	,,	,, ,,	2·26	,,	1·72	,,	3·92	,,	2·62	,,	1·22	,,	4·48	,,	8·27	,,
,, Holkham ,,	4	,,	,, ,,	1·96	,,	1·61	,,	3·45	,,	2·31	,,	1·12	,,	5·87	,,	8·80	,,